Fishery Data Series No. 95-20

Evaluation of Stocked Game Fish in the Tanana Valley, 1994

by

Cal Skaugstad,

Pat Hansen,

and

Mike Doxey

September 1995

Alaska Department of Fish and Game

Division of Sport Fish

Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used in Division of Sport Fish Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications without definition. All others must be defined in the text at first mention, as well as in the titles or footnotes of tables and in figures or figure captions.

Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
metric ton	mt
milliliter	ml
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
ounce	oz
pound	lb
quart	qt
yard	yd

Spell out acre and ton.

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
hour (spell out for 24-hour clock)	h
minute	min
second	s

Spell out year, month, and week.

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

All commonly accepted abbreviations.	e.g., Mr., Mrs., a.m., p.m., etc.
All commonly accepted professional titles.	e.g., Dr., Ph.D., R.N., etc.
and	&
at	@
Compass directions:	
east	E
north	N
south	S
west	W
Copyright	©
Corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
et alii (and other people)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.,
id est (that is)	i.e.,
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
number (before a number)	# (e.g., #10)
pounds (after a number)	# (e.g., 10#)
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S. state and District of Columbia abbreviations	use two-letter abbreviations (e.g., AK, DC)

Mathematics, statistics, fisheries

alternate hypothesis	H_A
base of natural logarithm	e
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	F, t, χ^2, etc.
confidence interval	C.I.
correlation coefficient	R (multiple)
correlation coefficient	r (simple)
covariance	cov
degree (angular or temperature)	°
degrees of freedom	df
divided by	÷ or / (in equations)
equals	=
expected value	E
fork length	FL
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
mideye-to-fork	MEF
minute (angular)	'
multiplied by	x
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
standard length	SL
total length	TL
variance	Var

FISHERY DATA SERIES NO. 95-20

EVALUATION OF STOCKED GAME FISH IN THE TANANA VALLEY, 1994

by

Cal Skaugstad,
Division of Sport Fish, Fairbanks
Pat Hansen,
Division of Sport Fish, Anchorage
and
Mike Doxey
Division of Sport Fish, Fairbanks

Alaska Department of Fish and Game
Division of Sport Fish, Research and Technical Services
333 Raspberry Road, Anchorage, Alaska, 99518-1599

September 1995

Development and publication of this manuscript were partially financed by the Federal Aid in Sport Fish Restoration Act (16 U.S.C. 777-777K) under Project F-10-10, Job No. E-3-1.

The Fishery Data Series was established in 1987 for the publication of technically oriented results for a single project or a group of closely related projects. Fishery Data Series reports are intended for fishery and other technical professionals. Distribution is to state and local publication distribution centers, libraries and individuals and, on request, to other libraries, agencies, and individuals. This publication has undergone editorial and peer review.

Cal Skaugstad
Alaska Department of Fish and Game, Division of Sport Fish, Region III,
1300 College Road, Fairbanks, AK 99701-1599,USA
Pat Hansen
Alaska Department of Fish and Game, Division of Sport Fish, Research and Technical Services,
333 Raspberry Road, Anchorage, AK 99518-1599, USA
Mike Doxey
Alaska Department of Fish and Game, Division of Sport Fish, Region III,
1300 College Road, Fairbanks, AK 99701-1599,USA

This document should be cited as:
Skaugstad, C., P. Hansen, and M. Doxey. 1995. Evaluation of stocked game fish in the Tanana Valley, 1994. Alaska Department of Fish and Game, Fishery Data Series No. 95-20, Anchorage.

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ABSTRACT

Gill nets and fyke nets were used to sample the populations of game fish age 1 and older in Birch, Quartz, and Chena lakes. The sample compositions for all lakes were 63% to 74% rainbow trout, 17% to 34% coho salmon, 6% Arctic grayling, and 2% to 3% Arctic char. The CPUE for rainbow trout was highest near-shore in Birch Lake and Chena Lake but highest off-shore in Quartz Lake. For coho salmon the highest CPUE was off-shore in Birch Lake and Quartz Lake but highest near-shore in Chena Lake. Arctic char, however, had the highest CPUE off-shore in all three lakes. The CPUE for Arctic grayling was highest off-shore in Birch Lake but highest near-shore in Chena Lake. Generally, the largest individuals of each species were captured in Quartz Lake. The size of the fish captured in Birch and Chena lakes were similar.

Studies in 1993 and 1994, along with mail out surveys and historical data provided information to assess how well ADF&G was progressing toward achieving management objectives. In 1992, none of the management objectives were achieved and only two objectives were achieved in 1993. However, recent changes made to the stocking program are having an effect and progress was made towards achieving more objectives. The total cost of the stocking program decreased from about $605,000 in 1992 (a historic high), to about $512,000 in 1993, and to about $293,000 in 1994. The number of days fished for stocked game fish in 1992 (about 49,700) was the lowest since 1986, but, in 1993 the number of days fished increased to about 68,300. The cost-per-day of fishing decreased from a historical high of about $12 in 1992 to about $7.50 in 1993. From 1989 through 1992 the percent of the total annual stocking cost by location was highest for Harding Lake (42% to 68%) and by species was highest for Arctic char (43% to 61%). Since 1992 the percent of the total annual stocking costs for Harding Lake dropped to about 5% and stocking costs for Arctic char dropped to 25%. Most of the cost reduction in the stocking program was the result of reducing the number of Arctic char that were stocked. Small lakes now account for about 50% of total annual stocking costs by location and rainbow trout account for about 40% of the total annual stocking costs by species. In 1993 the small lakes accounted for the most number of days fished on populations of stocked game fish (about 22,500 or 33% of the total number of days fished). The percent return to the creel in Quartz and Chena lakes for rainbow trout was 4.9% and 23.4%, respectively. The cost-to-the-creel for rainbow trout stocked as fingerlings ranged from $0.35 to $1.47; subcatchables ranged from $0.63 to $4.61; and catchables ranged from $0.42 to $12.11. Usually only one size cohort was stocked in a lake and a different size cohort was stocked in each lake. Previous studies showed that the cost per survivor to a certain size or age was lowest for fish stocked as fingerlings in Quartz Lake, subcatchables stocked in Birch Lake, and catchables stocked in Chena Lake. Coho salmon stocked as fingerlings provided a 14.8% return in Birch Lake, a 21.0% return in Quartz Lake and an 8.0% return in Chena Lake. The cost-to-the-creel for coho salmon that were stocked as fingerlings in all three lakes were variable through time ($0.29 to $3.36) but cost-to-the-creel between lakes for the same year were usually similar.

Key words: Birch Lake, Chena Lake, Quartz Lake, Harding Lake, stocking evaluation, Arctic char, *Salvelinus alpinus*, rainbow trout, *Oncorhynchus mykiss*, Arctic grayling, *Thymallus arcticus*, northern pike, *Esox lucius*, burbot, *Lota lota*, least cisco, *Coregonus sardinella*, lake trout, *Salvelinus namaycush*, kokanee, *Oncorhynchus nerka*, chinook salmon *Oncorhynchus tshawytscha*, catch per unit effort, growth, cost-per-day of fishing, stocking cost, days fished, fishing effort, cost-to-the-creel.

INTRODUCTION

The Alaska Department of Fish and Game (ADF&G) stocks game fish in numerous lakes and one stream in the Tanana River Valley (a portion of interior Alaska; Figure 1) to provide more angling opportunities near population centers and to reduce the harvest of native fish stocks. This stocking program provides diverse year-round sport fishing for rainbow trout *Oncorhynchus mykiss*, coho salmon *O. kisutch*, chinook salmon *O. tshawytscha*, Arctic grayling *Thymallus arcticus*, Arctic char *Salvelinus alpinus*, and lake trout *S. namaycush*.

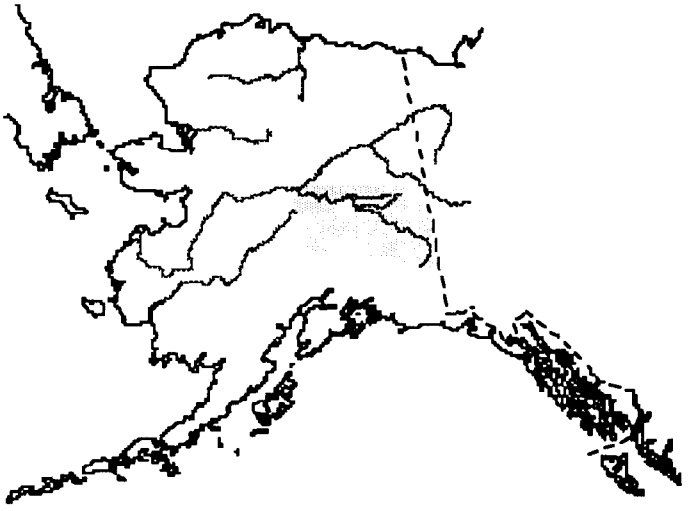

Figure 1.-The Tanana Valley (the shaded area).

The stocking program began in the early 1950's, when lakes along the road system were stocked with rainbow trout or coho salmon. Prior to stocking, some lakes were treated with rotenone to remove undesired species. Today, stocked fish represent more than half (about 68% in 1993) of the harvest of game fish in the Tanana Valley (Figure 2) and almost half (about 43% in 1993) of the total fishing effort (Figure 3). Fishing effort for a location is defined as the estimated number of days fished (DF) by all anglers for that location (Mills 1980-1994). Any part day fished by an angler is considered one whole day. In 1993, about 62% of the total harvest of wild and stocked fish in the Tanana Valley was attributed to just two stocked species; rainbow trout and landlocked coho salmon (Mills 1994).

Birch, Quartz, Chena, and Harding lakes are four of the more important locations for sport fishing in the Tanana Valley because they are large (from 100 to 1,000 ha), near population centers, and on the road system. In 1993, stocked rainbow trout and coho salmon harvested from Birch, Quartz, and Chena lakes provided 47% of the total harvest of wild and stocked fish in the Tanana Valley (Mills 1994). Harding Lake, while the largest lake in the Tanana Valley supported less fishing effort on stocked game fish than any other location. Harding Lake is one of the few lakes included in the stocking program that has self sustaining populations of burbot *Lota lota*, northern pike *Esox lucius*, and lake trout.

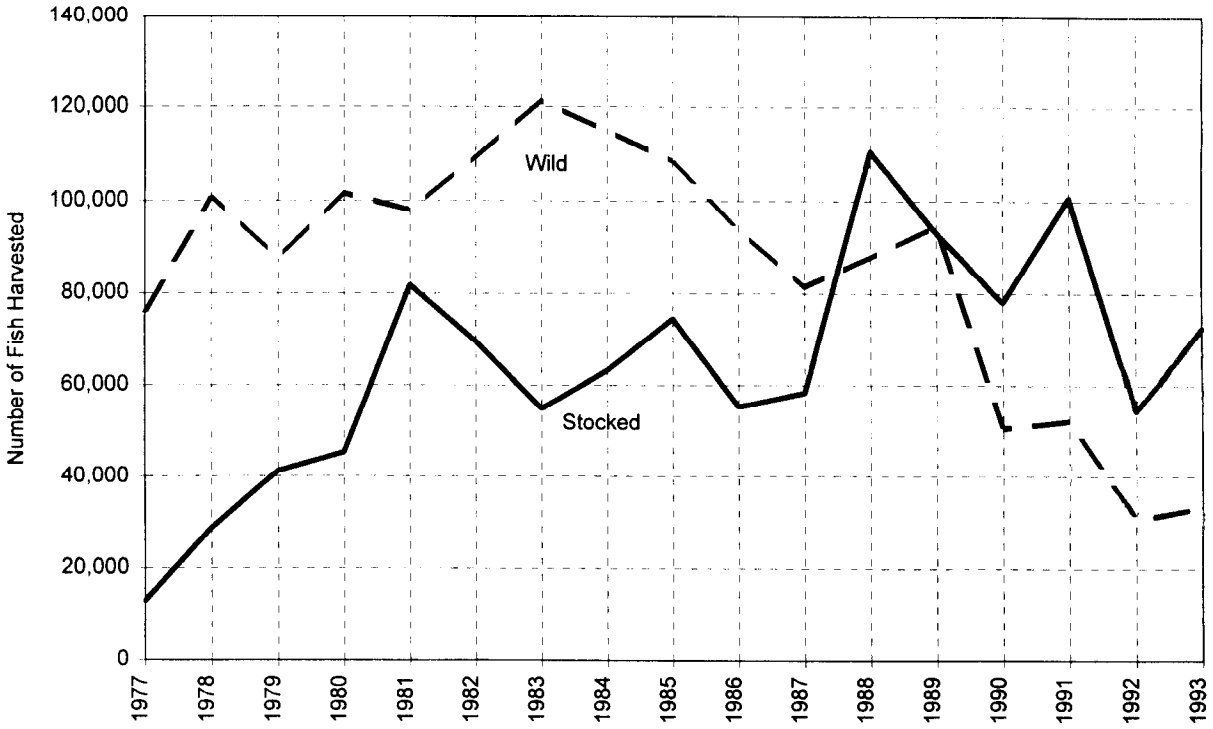

Figure 2.-Number of fish harvested from populations of stocked and wild game fish in the Tanana Valley.

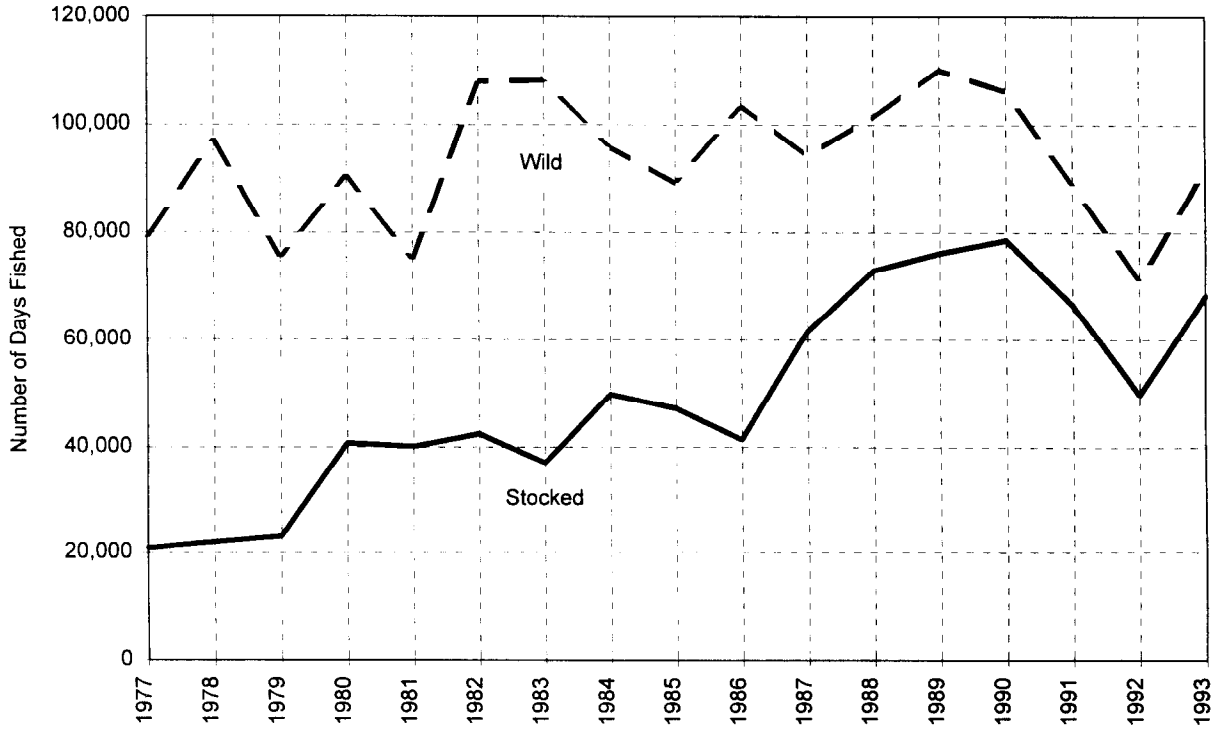

Figure 3.-Number of days fished on populations of stocked and wild game fish in the Tanana Valley.

Piledriver Slough, a clearwater stream near Fairbanks, supports another important fishery. Until the upstream portion of the slough was blocked in 1976 to control flooding, a portion of the Tanana River flowed through the slough, and estimated fishing effort was less than 1,000 DF. Rainbow trout are now stocked in the slough and it has been colonized by wild Arctic grayling which also contribute to the fishery. Total fishing effort is comparable to that for the three major lakes (Mills 1994). Usually about one-half of the total fishing effort is attributed to stocked rainbow trout (Figure 4).

In addition to stocking the large lakes, more than 80 small lakes (from 1 to 80 ha) also are stocked with rainbow trout, coho salmon, chinook salmon, Arctic grayling, Arctic char, and lake trout. The majority of these small lakes are along the road system or within easy walking distance from a road. Fewer than 10 lakes are more distant and are reached by off-road vehicle, snow machine, or aircraft. The total fishing effort produced at these small lakes has been increasing since 1986 (Figure 4). In 1993, the small lakes in combination represent more effort than any other sport fishery on either wild or stocked populations of game fish in the Arctic-Yukon-Kuskokwim (AYK) region.

In 1991, ADF&G significantly changed the species and numbers of game fish stocked in the Tanana Valley according to Fishery Management Plans (FMP) developed for Birch, Quartz, Chena, and Harding lakes, Piledriver Slough, and a group of about 80 small lakes (ADF&G 1993). The FMPs were established from fishery studies, angler surveys, and creel surveys conducted since the 1970's. Birch, Quartz, and Chena lakes traditionally were stocked with only rainbow trout and coho salmon, but are now are stocked with different combinations of Arctic char, Arctic grayling, coho salmon, chinook salmon, and rainbow trout. Stocking fingerling rainbow trout in Quartz Lake and subcatchable rainbow trout in Birch Lake provided the lowest cost-to-a-catchable size. Catchable-sized rainbow trout were stocked in Chena Lake because growth rates were low for fish stocked as fingerlings or subcatchable-sized fish. To reduce stocking costs but maintain fishing effort in Piledriver Slough, ADF&G decreased the number of rainbow trout released but increased the size of these fish when stocked. Harding Lake received a major portion of the stocking program from 1989 through 1992 but yielded only a low level of effort. As a result, the stocking of game fish in Harding Lake was greatly reduced. An objective of the management plan for the small lakes was to provide about 20,000 DF each year by emphasizing lakes with the greatest potential for increased fishing effort based on proximity to population centers, road access, and size (surface area). We diverted more resources toward these lakes by stocking more fish and/or larger fish, and providing additional promotion of these small lakes through informational handouts to anglers and news releases.

Objectives in the FMPs such as providing annual mean catch rates and limiting stocking costs serve to guide ADF&G in management of these fisheries. The studies summarized in this report are intended to provide fishery managers with information to assess how well ADF&G is progressing toward achieving these management objectives.

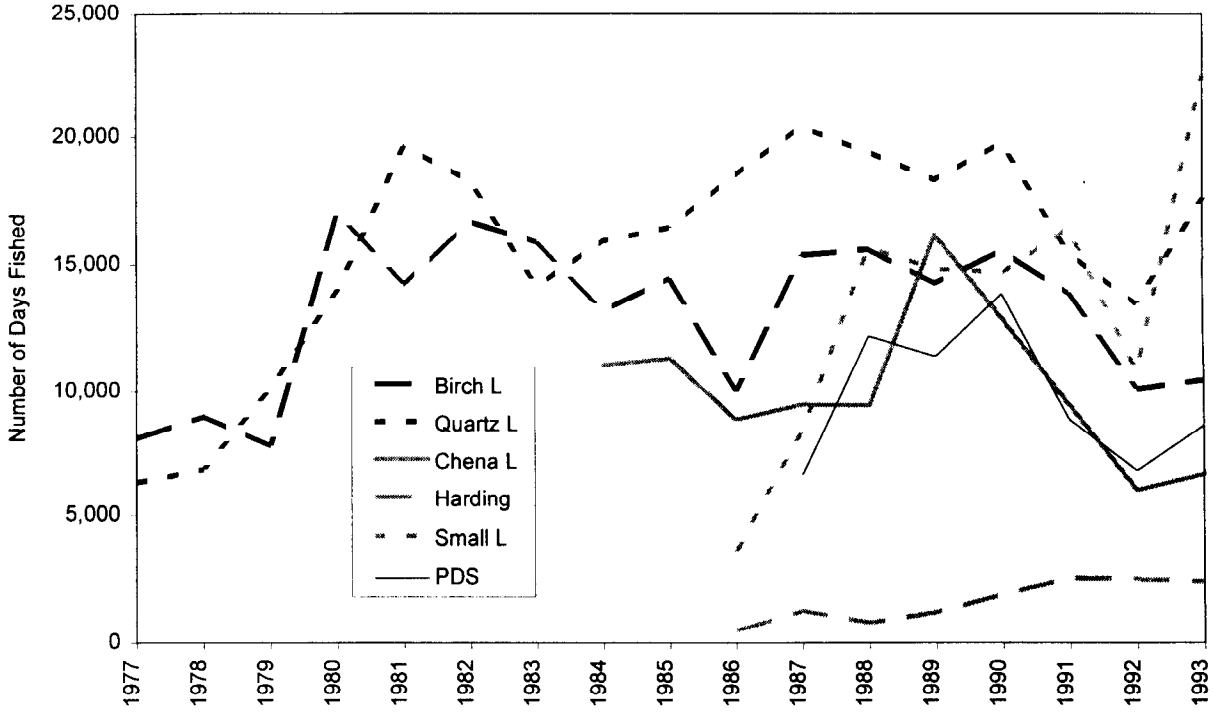

Figure 4.-Number of days fished on populations of stocked game fish for the major locations in the Tanana Valley.

Following are the objectives of studies conducted to monitor the stocking program, Project F-10-10, Job E-3-1.

1. Estimate the proportions of:

a) age 1 Arctic grayling, rainbow trout and coho salmon and age 2 and older Arctic char in Birch Lake;

b) age 1 rainbow trout, coho salmon, and age 2 and older Arctic char in Quartz Lake; and,

c) age 1+ Arctic grayling, rainbow trout, coho salmon, and Arctic char in Chena Lake.

In addition, there were the following tasks to evaluate progress toward achieving the fishery management objectives for Birch, Quartz, and Chena lakes.

1. Estimate the annual and total contribution to the harvest of different stocking cohorts of rainbow trout and coho salmon.
2. Evaluate cost-per-day of fishing (CPDF) for the major sport fishing locations in the stocking program to determine if the fishery management objectives were achieved.

BIRCH, QUARTZ, AND CHENA LAKES

During studies in 1993, few Arctic char were captured in fyke nets in Birch Lake, Quartz Lake, and Chena Lake (Skaugstad et al. 1994). Fyke nets were set in the littoral zones (water depth less than 2 m) and captured rainbow trout, Arctic grayling, and coho salmon. If catches were proportional to abundance, few Arctic char were present in the littoral zone in Birch Lake, Quartz Lake, and Chena Lake. Two possible reasons why few Arctic char were captured in fyke nets are: 1) the abundance of Arctic char was very low, or 2) Arctic char were abundant, but most of the population was not in the littoral zone. Previous studies suggest that Arctic char may be found in littoral or pelagic zones depending on the size of a lake. In small lakes (less than 20 ha) Arctic char were captured in fyke nets set in the littoral zone (Skaugstad and Clark 1991). However, in Harding Lake (1,000 ha) more Arctic char were captured away from shore (pelagic) in gill nets than near shore (littoral) in fyke nets (Skaugstad 1993). In Harding Lake, the capture rates also may have been an artifact of the type of gear used in the littoral and pelagic zones. Catch rates in the littoral zone may have been higher if gill nets had been used. If Arctic char were less likely to be captured with fyke nets in the littoral zone of a large lake such as Harding Lake, the same result may occur in Birch Lake (324 ha), Quartz Lake (602 ha), and Chena Lake (104 ha).

Usually, rainbow trout larger than 20 g (age 1) were stocked in Birch and Chena lakes and rainbow trout smaller than 4 g (age 0) were stocked in Quartz Lake because cost-per-survivor to a catchable size (~150 mm) was less when subcatchables were stocked in Birch and Chena lakes and was less when fingerlings were stocked in Quartz Lake. Fingerlings were stocked in Quartz Lake at age 0 in 1992, 1993, and 1994. Subcatchables were stocked in Birch and Chena lakes at age 1 in 1993 and 1994. Subcatchables were from a portion of the cohort that was not stocked at age 0 but were kept in the hatchery and stocked the following spring. Arctic grayling, coho salmon, and Arctic char were age 0 when stocked. Recent stocking histories for these lakes are listed in Appendix A. For this report the definition of fingerlings was 0.8 g to 11 g, subcatchables

was >11 g to 65 g and catchables was >65 g. These are arbitrary categories that serve only to coarsely describe the size of fish.

Because of recent changes to the stocking program in large lakes, Birch, Quartz, and Chena (Figures 5, 6, and 7), it was important to monitor the status of the rainbow trout and coho salmon populations which contribute about 47% of the harvest of all species, both wild and stocked, in the Tanana Valley. Length frequency distributions were used to monitor the status of these species and recently introduced Arctic char and Arctic grayling in these lakes. This type of sampling provides immediate information on the status of age 1 fish before they recruit to the fishery. If a stocking failed, length frequency distributions would probably provide evidence of a lost age cohort. Knowing that a stocking failed, fishery managers can compensate with additional stockings using different methods next year. The SWHS and catch sampling do not provide fishery managers with information in time to compensate for a failed stocking.

METHODS

Each lake was divided into two depth zones, littoral and pelagic, with six fyke nets set in the littoral zone (< 2 m) and two sinking gill nets in the pelagic zone (> 2 m). In addition, two gill nets were used in the littoral zone to determine if Arctic char were present but avoided fyke nets. At each lake, fyke nets were set and then checked after about 48 hours. Gill nets were fished for three to four hours each day while the crew was setting or pulling fyke nets. Live fish captured the first day in gill nets were released unmarked. Gill nets were not set over night to prevent killing a large number of the larger game fish.

Fyke net openings were 1.2 m sq., mesh size was 9 mm sq., wings were 7.5 m long, and the center lead was 30 m long. The fyke nets were distributed roughly equal distance around the lake perimeter. Four fyke nets were set in each lake with the center leads perpendicular to shore and wings parallel to shore. The end of the center lead opposite the fyke net was anchored to shore and a weight was attached to the cod end to prevent the fyke net from collapsing. Center leads were 30 m by 1.2 m for sampling in Birch and Quartz lakes but were shortened as necessary in Chena Lake so that fyke nets were not set in water deeper than 1.2 m. In addition two fyke nets were set in each lake with the body of the net parallel to shore and the wings forming a "V". One wing was anchored to shore. A weight was attached to the other wing and positioned off shore.

Gill nets were 37 m by 1.8 m with six 6.1m panels and made of monofilament. Each panel had a different size mesh. Square measure and strand diameter of the mesh was 12.7 mm and 0.20 mm, 15.9 mm and 0.20 mm, 19.1 mm and 0.25 mm, 25.4 mm and 0.30 mm, 38.1 mm and 0.30 mm, and 50.8 mm and 0.30 mm. The nets were weighted to sink and had a green polycore float line. A 2 kg weight was attached to each end to hold the net in position.

All captured fish except the fingerlings were measured to the nearest millimeter (FL). In previous studies most age 0 rainbow trout, coho salmon, and Arctic grayling collected in September and October were less than 140 mm (Doxey 1991, Skaugstad 1993). Age 0 fish stocked in 1994 were not used in further analysis.

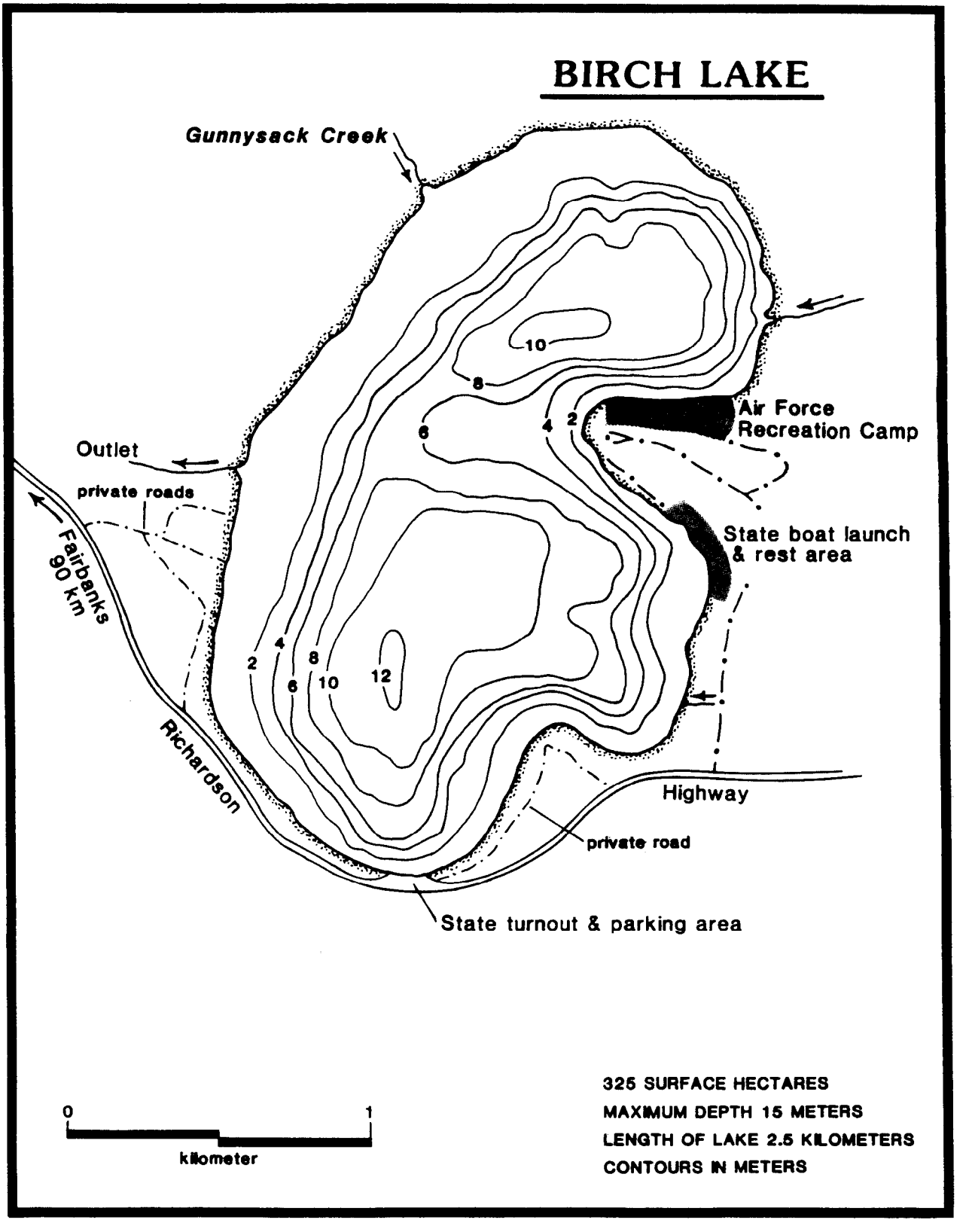

Figure 5.-Birch Lake.

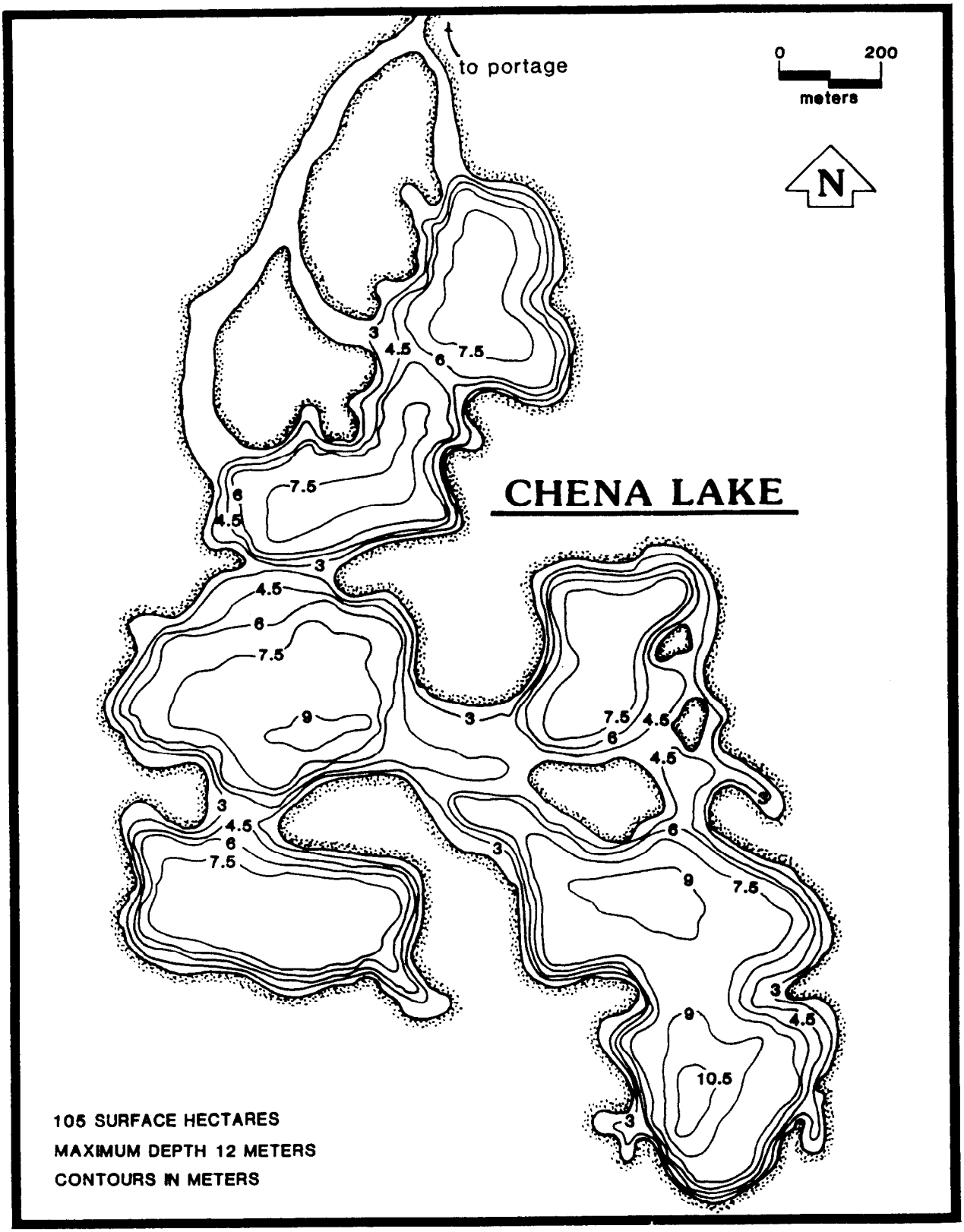

Figure 6.-Quartz Lake.

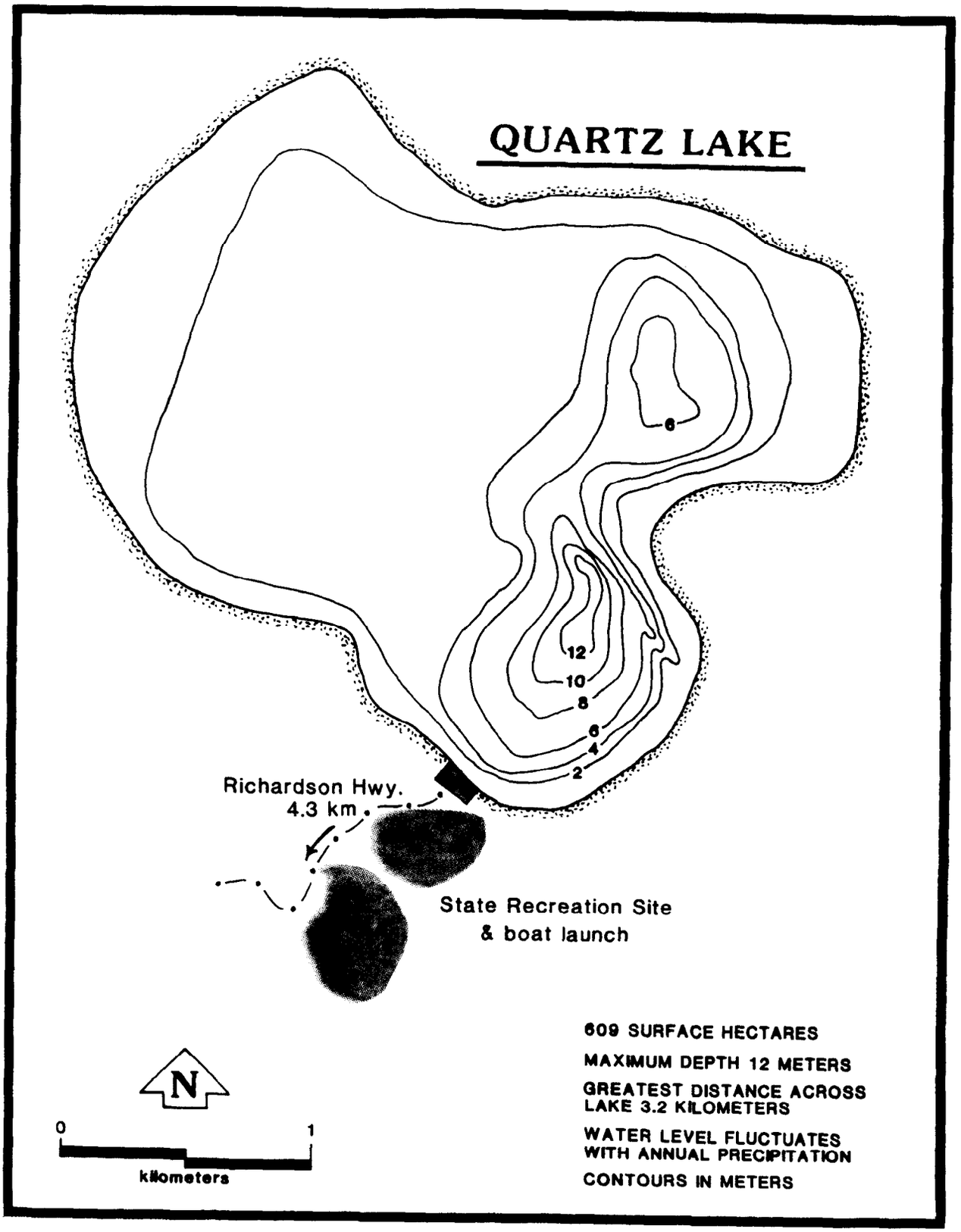

Figure 7.-Chena Lake.

Originally, captured fish were to be assigned age 1 or age 2+ (age 2 and older) by examining the distribution of length frequencies for each species. The analysis was based on histograms of length data separated into 10 mm intervals. However, except for data collected from Quartz Lake, the length frequency histograms showed no definite separation between age cohorts as was found in samples collected before 1992. Instead, for each lake the species composition of the samples were estimated for fish age 1 and older (age 1+). The length interval between modes for age 0 (when present) and age 1+ with the lowest frequency was the critical interval for separating the age cohorts. The critical interval was assigned to the age 1+ category. Previous studies using marked fish showed that the majority of small fish were age 1+ (Doxey 1989). Because the smaller age 1+ fish could be misclassified as age 0, the number of age 1+ fish in the sample was a minimum estimate.

These estimates represent the population proportions only if all species were captured in proportion to its abundance in the lake. This study was not designed to evaluate sampling bias. As a result we do not know if these estimates represent the population proportions.

RESULTS

Data collected from sampling and estimates of proportions are summarized in Table 1 and Figures 8-11. Data collected from 1993 were included for comparison. All data were for fish 150 mm and larger (age 1+). In Birch Lake, 186 rainbow trout, 66 coho salmon, 6 Arctic char, and 16 Arctic grayling were captured. The proportions, by species, in the sample were: rainbow trout 0.68 (SE = 0.028); coho salmon 0.24 (SE = 0.026); Arctic char 0.022 (SE = 0.0089); and Arctic grayling 0.058 (SE = 0.014). In Quartz Lake, 129 rainbow trout, 70 coho salmon, and 5 Arctic char were captured. The proportions by species, in the sample were: rainbow trout 0.63 (SE = 0.034), coho salmon 0.34 (SE = 0.033), and Arctic char 0.025 (SE = 0.033). In Chena Lake, 277 rainbow trout, 62 coho salmon, 10 Arctic char, and 24 Arctic grayling were captured. The proportions, by species in the sample were: rainbow trout 0.74 (SE = 0.023); coho salmon 0.17 (SE = 0.019); Arctic char 0.027 (SE = 0.0084); and Arctic grayling 0.064 (SE = 0.013).

Catches and catch per unit of effort (CPUE) by species, gear type, and depth strata are summarized in Table 2. Generally, all species were captured in fyke nets and gill nets in all three lakes. However, catches and CPUE by species, gear type, and depth strata were not consistent between lakes. For example, the CPUE for rainbow trout was highest near-shore (fyke nets and near-shore gill nets combined) in Birch Lake and Chena Lake but highest off-shore in Quartz Lake. For coho salmon the highest CPUE was off-shore in Birch Lake and Quartz Lake but highest near-shore in Chena Lake. Arctic char, however, had the highest CPUE off-shore in all three lakes. The CPUE for Arctic grayling was highest off-shore in Birch Lake but highest near-shore in Chena Lake.

DISCUSSION

As an example of the ability to detect gross changes in populations the sampling program in 1993 showed the age 1 cohorts of coho salmon were missing from Birch and Quartz lakes (Figure 9), yet age 0 and 2 cohorts from stockings in 1991 and 1993 were present. Generally, the length distributions for coho salmon captured at Birch and Quartz lakes have three modes with each mode indicating a different age cohort. In 1987 the mean lengths by age of coho salmon captured at Birch Lake were 117 mm (age 0), 209 mm (age 1), and 260 mm (age 2) (Doxey 1988). The mean lengths by age of coho salmon captured at Quartz Lake were slightly larger. These fish

Table 1.-Numbers of fish 150 mm and larger captured by species and species composition for Birch Lake, Quartz Lake and Chena Lake, 1993-94.

Species	Birch Lake			Quartz Lake			Chena Lake		
	n [a]	p [b]	se [c]	n [a]	p [b]	se [c]	n [a]	p [b]	se [c]
1993									
Rainbow trout	421	0.58	0.018	213	0.68	0.026	383	0.59	0.019
Coho Salmon	129[d]	0.18	0.014	92	0.30	0.026	129	0.20	0.016
Arctic char	17	0.024	0.0057	6	0.019	0.0078	78	0.12	0.013
Arctic grayling	154	0.21	0.015	Not stocked			55	0.085	0.011
Total	721			311			645		
1994									
Rainbow trout	186	0.68	0.028	129	0.63	0.034	277	0.74	0.023
Coho Salmon	66	0.24	0.026	70	0.34	0.033	62	0.17	0.019
Arctic char	6[d]	0.022	0.0089	5[d]	0.025	0.011	10	0.027	0.0084
Arctic grayling	16	0.058	0.014	Not stocked			24	0.064	0.013
Total	274			204			373		

[a] Number of each species in the sample.

[b] Proportion of each species in the sample.

[c] Standard error of the estimated proportion.

[d] There were no age 1 fish of this species in the lake because no age 0 fish were stocked the previous year.

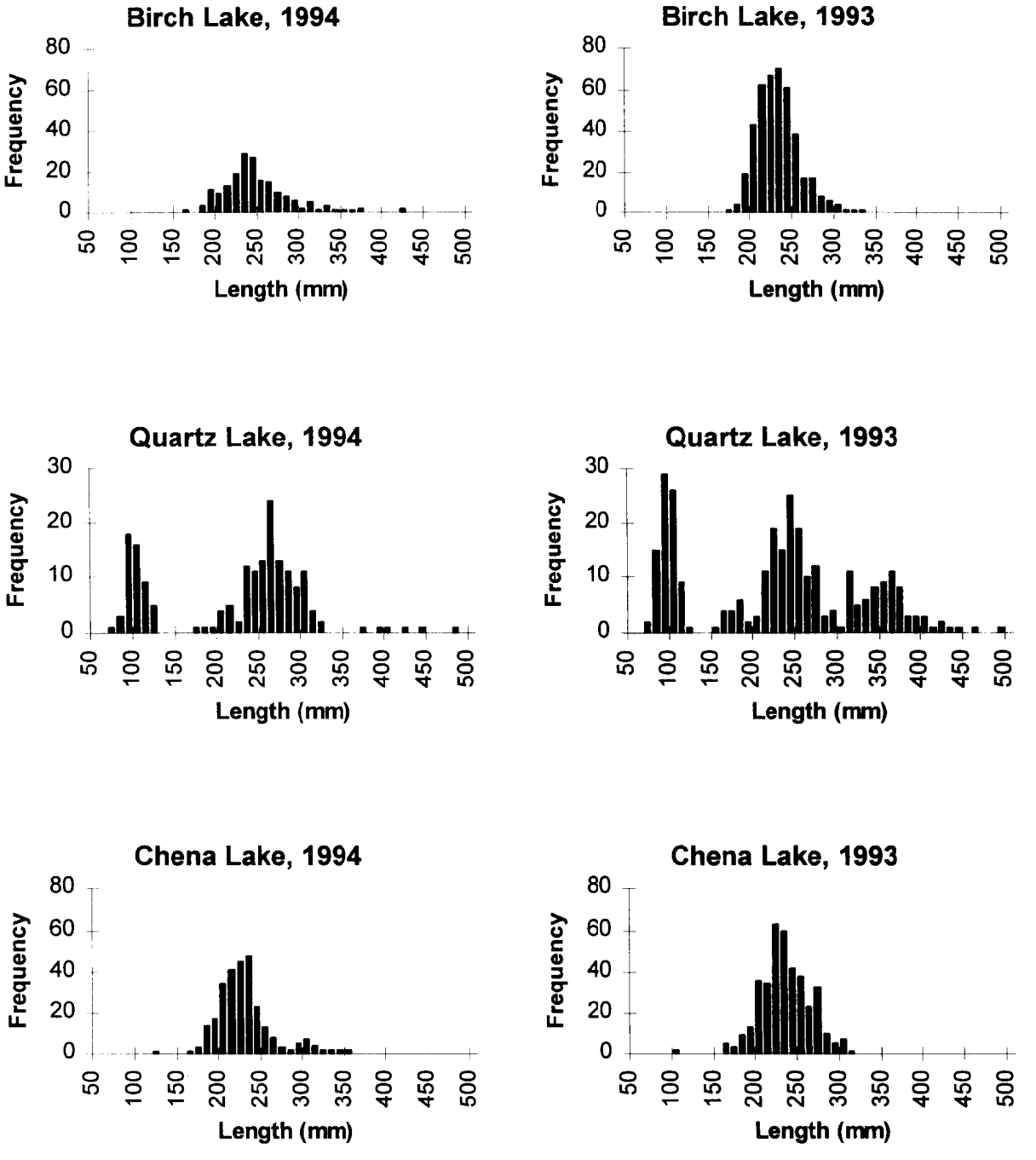

Figure 8.-Length frequency histograms of rainbow trout captured in Birch, Quartz, and Chena lakes, 1993 and 1994.

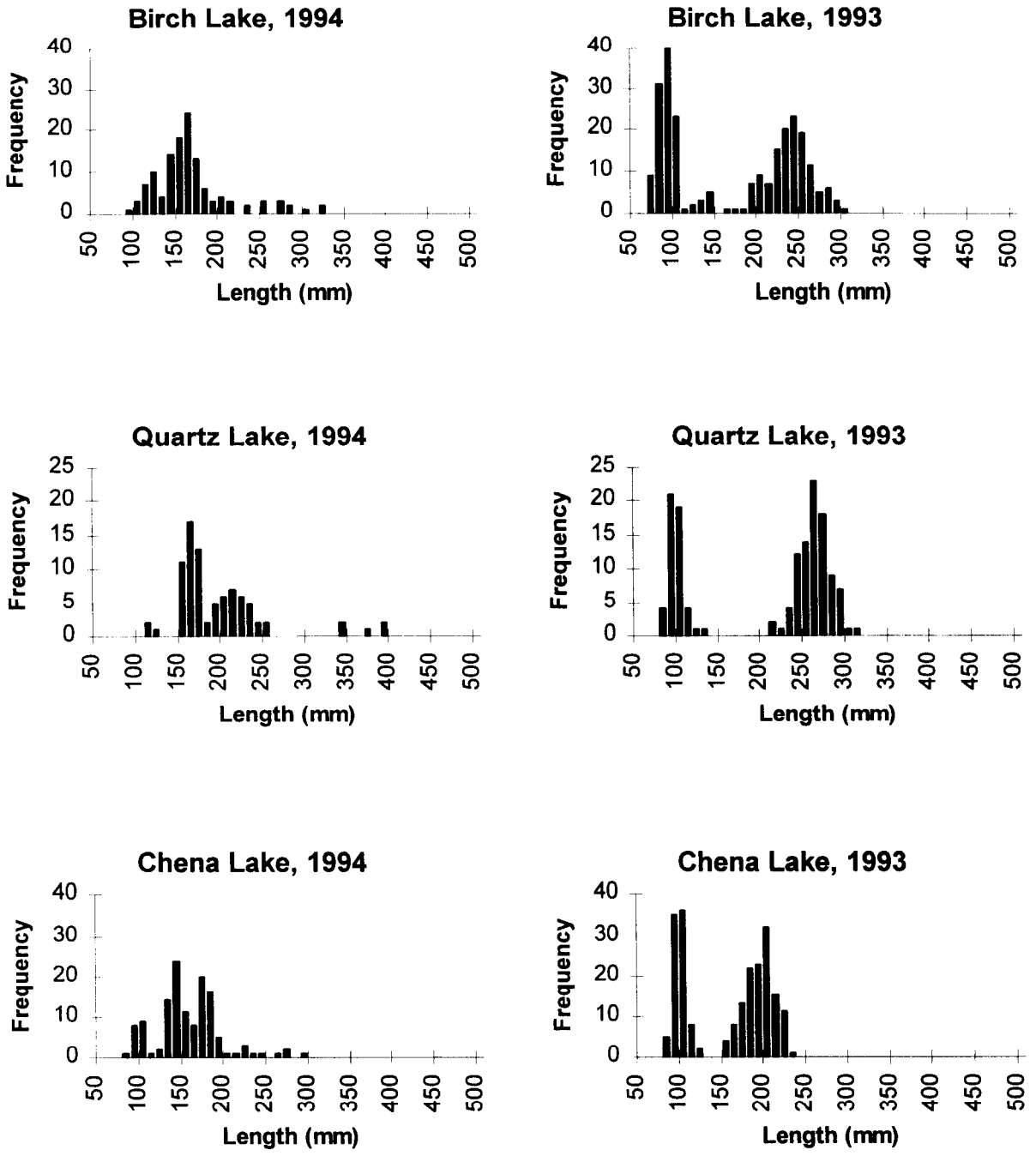

Figure 9.-Length frequency histograms of coho salmon captured in Birch, Quartz, and Chena lakes, 1993 and 1994.

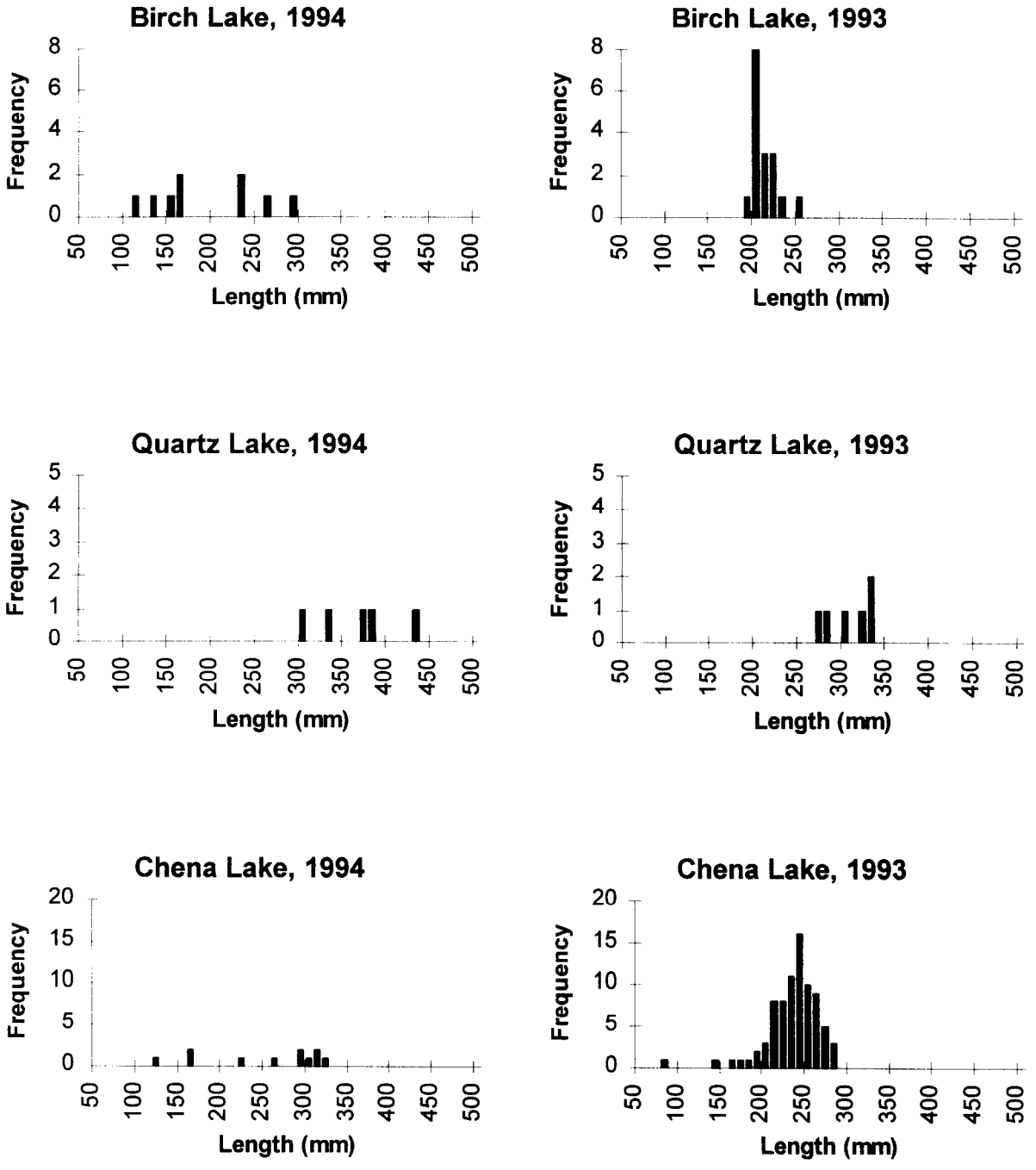

Figure 10.-Length frequency histograms of Arctic char captured in Birch, Quartz, and Chena lakes, 1993 and 1994.

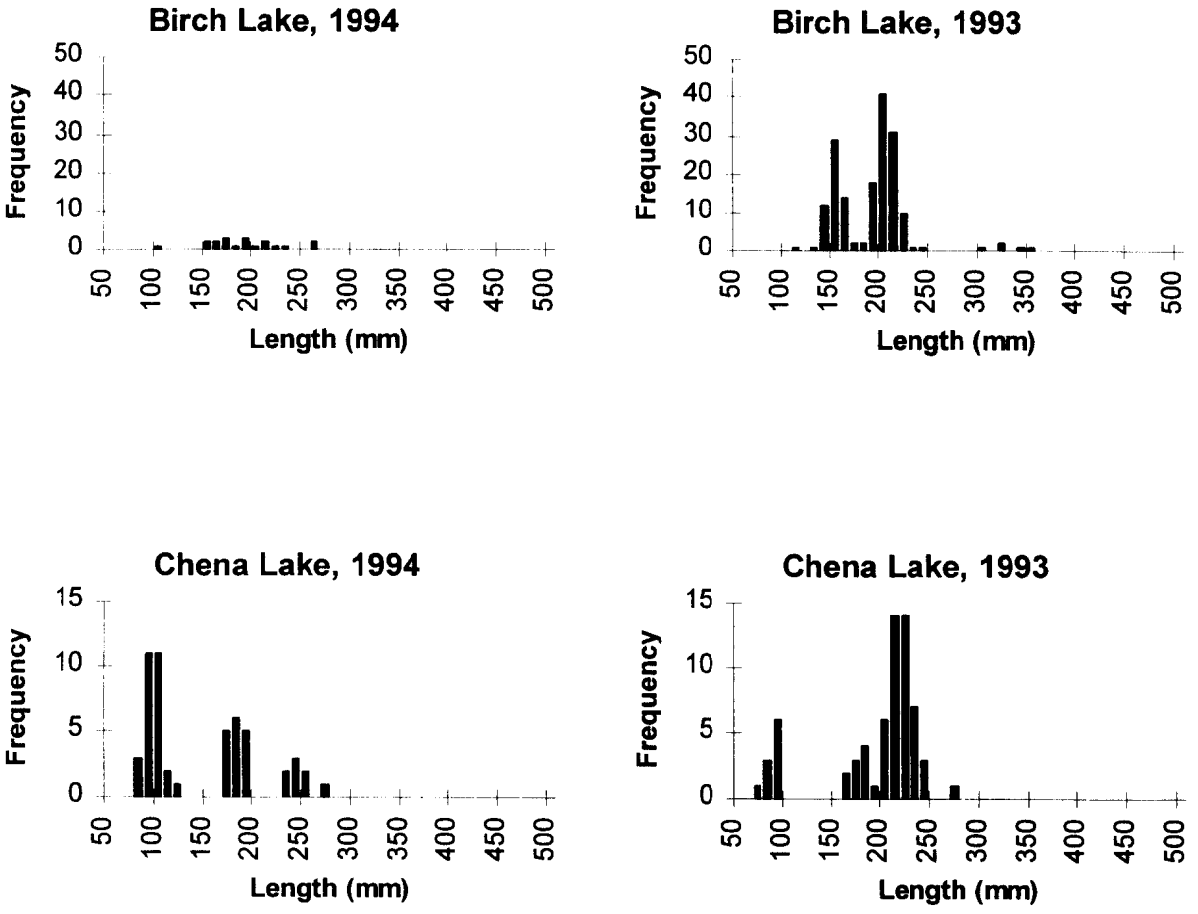

Figure 11.-Length frequency histograms of Arctic grayling captured in Birch, Quartz, and Chena lakes, 1993 and 1994.

Table 2.-Number, effort, and CPUE of fish 150 mm and larger captured by gear type and location for Birch Lake, Quartz Lake and Chena Lake, 1994.

	Birch Lake			Quartz Lake			Chena Lake		
	GN-NS[a]	GN-OS[b]	Fyke[c]	GN-NS[a]	GN-OS[b]	Fyke[c]	GN-NS[a]	GN-OS[b]	Fyke[c]
Rainbow trout	29	4	153	7	13	109	17	4	256
Effort[d]	5	9.25	192	9	9	192	11.5	11.5	192
CPUE	5.8	0.43	0.8	0.78	1.44	0.57	1.48	0.35	1.33
Coho Salmon	0	9	57	3	3	64	7	0	55
Effort[d]	5	9.25	192	9	9	192	11.5	11.5	192
CPUE	0	0.97	0.3	0.33	0.33	0.33	0.61	0	0.29
Arctic char	0	2	4	0	3	2	1	4	5
Effort[d]	5	9.25	192	9	9	192	11.5	11.5	192
CPUE	0	0.22	0.02	0	0.33	0.01	0.09	0.35	0.03
Arctic grayling	0	8	8				0	0	24
Effort[d]	5	9.25	192				11.5	11.5	192
CPUE	0	0.86	0.04				0	0	0.13
Total Catch	29	23	222	0	29	175	25	8	340

[a] Gill net near-shore.

[b] Gill net off-shore.

[c] Fyke net near-shore.

[d] Effort is the total number of hours that all nets fished at a given depth strata (gill net near-shore, gill net off-shore, and fyke net).

were captured in mid September at Birch Lake and mid October at Quartz Lake. In 1993 the modes for the age 1 cohorts were missing for fish captured at Birch and Quartz lakes. We know the age 1 cohorts were missing because in 1992 no coho salmon fingerlings were stocked. Chena Lake, however, was stocked with age 0 coho salmon subcatchables (~120 mm) in the fall of 1992 and it did not show a missing age 1 cohort in 1993. Subcatchables were stocked because they were the appropriate size for Arctic grayling in the fall. Data collected in 1994 indicated that most of the Arctic char population was offshore away from the littoral zone in all three lakes. Compared to other species few Arctic char were captured in 1993 and again in 1994. If each species was captured in proportion to its abundance then these data suggest that the abundance of Arctic char was low. However, these data should not be used to estimate the relative abundance of the different species in a lake. Because catch rates probably vary by species, the relative abundance of the different species in the sample may not be a good indicator of the relative abundance of the populations.

Although the species composition in the samples that were collected in 1993 and 1994 showed changes within a lake (Table 1) we can not attribute these changes to stocking modifications or to any other cause. There were too many uncontrolled factors such as natural and fishing mortality, and number, size and time that fish were stocked that could affect the species composition.

BROOD TABLES AND COST-TO-THE-CREEL

METHODS

Brood Tables

The rainbow trout and coho salmon stocking programs for Birch, Chena and Quartz lakes were evaluated using brood tables to estimate the annual and total contribution to the harvest of each stocking cohort. A cohort is defined as a group of similar size and age fish (fingerling, subcatchable, or catchable) of the same species that were released in the same stocking event. A stocking event was defined as a release of fish that was unique based on the time and location of the stocking. For example, a cohort of rainbow trout fingerlings stocked in 1991 was considered a different cohort from subcatchable rainbow trout that were stocked in 1991. And both of these cohorts were different from a cohort of rainbow trout fingerlings stocked in 1992. The definition of fingerlings was 0.8 g to 11 g, subcatchables was >11 g to 65 g and catchables was >65 g. These cohorts represent a crude method of classification for the purpose of assigning average rates of survival within a cohort. Rates of survival were assumed to be similar for all fish within a cohort even though the average weight could be very different for groups of fish classified as the same cohort. We justified our classification on the assumption (after examination of data) that rates of survival were more similar within than between these cohorts and rates of survival generally increased with increased size of the fish at the time of stocking. When possible we used actual estimates of survival rates from mark-recapture experiments or an average of these estimates within a cohort.

Each brood table was based on the following five types of information.

1. Number, size, and stocking date of each cohort.

   The number of fish stocked, size at stocking, and date of stocking was known for all years and is presented in Appendix A.

2. Estimated recruitment to the fishery.

   Rainbow trout were considered fully recruited to the fishery at 180 mm FL (Doxey 1991). Abundance estimates were available for rainbow trout in recent years and were used to estimate survival rate from stocking to catchable size and the recruitment into the fishery (Doxey 1980-1989, 1991; Hallberg 1984-1985; Kramer 1977; Kramer and Hallberg 1982; Appendices B1 and B2).

3. Total annual harvest estimates.

   A mail survey, Alaska Statewide Harvest Survey (SWHS; Mills 1980-1994) estimated the annual harvest of rainbow trout and coho salmon in each lake beginning in 1977. These harvest estimates could not be used to assign harvest to specific stocking cohorts, but they represent an overall estimate of the annual contribution for all stocking cohorts.

4. Average annual natural mortality estimates.

   The average natural mortality rate was calculated as:

$$n_{i+1} = n_i + r_{i+1} - h_i - m_i \qquad (1)$$

where:

n_{i+1} = number of fish in year i+1,

n_i = number of fish in year i,

r_{i+1} = recruitment in year i,

h_i = harvest in year i; and,

m_i = natural mortality in year i.

   With estimates of abundance, harvest and recruitment, the number of fish that died naturally can be easily calculated. The natural mortality rate is then expressed as a proportion of the number of fish in year i. The average natural mortality rate was then used in the brood tables.

5. Estimated angler preferences for size.

   Creel surveys at Birch and Quartz lakes were used to determine anglers' preference for various sizes of fish and apportion the harvest among the cohorts. Creel data showed that the proportion of larger fish in the harvest was greater than what was estimated for the size composition of the population). One possible explanation as to why larger fish were more likely to be harvested was that anglers were more likely to keep larger fish and release smaller fish. The angler preference was a correction factor which minimizes absolute difference between the creel data and the population data (Baker 1988; Clark and Ridder 1987; Appendix C).

The following assumptions were made.

1. The estimated annual natural mortality was constant across years.

2. The angler preference was the same for all lakes and years.

The brood tables work in the following way.

1. A cohort was stocked into a lake and the survival to catchable size was estimated and this number was then the first entry in the brood table.

2. The number of fish which survived to catchable size was then discounted for natural mortality and timing (fish unavailable for capture due to size or time of stocking) in the following manner:

   a. Fingerlings and subcatchable sized rainbow trout did not reach catchable size until the eighth month of the calendar year. Therefore, the first year harvest and annual natural mortality of these cohorts were reduced by a factor of 0.67.

   b. Rainbow trout of catchable size were not stocked until the sixth month of the calendar year. Therefore the first year of harvest and annual natural mortality were reduced by a factor of 0.50 prior to estimating proportions.

   c. Age 3 coho salmon near the end of their lives were less likely to be caught because they tend to not eat and were not attracted to lures or bait. The number of harvestable age 3 salmon was reduced by 10%.

   Those fish unavailable for capture due to timing were added back into the available number the second year (except age 3 coho).

3. The proportion of the total abundance represented by each cohort was then calculated.

4. The proportion of the cohort in the population was then corrected for angler preference.

5. The adjusted proportion was used to apportion the harvest of that year among the various cohorts. If there were not enough fish of the preferred size more fish of the next preferred cohort were harvested.

Cost-to-the-Creel

The brood tables and stocking costs were used to estimate the cost-to-the-creel for the different stocking cohorts of rainbow trout and coho salmon in Birch, Quartz, and Chena lakes. The total number of fish from a cohort that were harvested was obtained by summing the number of fish estimated to have been harvested each year from that cohort. These numbers were obtained directly from the brood tables. The methods used to determine stocking costs for the different cohorts are described in the section *Assessment of Fishery Management Objectives*. The cost-to-the-creel was calculated using:

$$b = \frac{c_j}{\sum_{i=1}^{y} h_i} \qquad (2)$$

where:

c_j = cost of fish stocked in stocking event j;

h_i = number of fish harvested from a cohort in year *i*;

b = cost-to-the-creel for a cohort; and,

y = number of years cohort is harvested.

Estimates of the cost-to-the-creel were made only for the cohorts that were stocked in 1986 or later and that had complete harvest records. For example: the cost-to-the-creel for the cohort of fingerling rainbow trout stocked in Quartz Lake in 1991 was not calculated because the harvest in 1994 has not been estimated. Because a portion of this cohort would have been harvested in 1994 the harvest record was not complete. Stocking costs were obtained from an audit of production and financial records from Clear Hatchery, Ft. Richardson Hatchery, Elmendorf Air Force Base Hatchery, and Big Lake Hatchery. Data requested from each hatchery were: total operating budget, total weight of fish produced, the average weight of fish released in a stocking event, and the number of fish released in a stocking event. A stocking event was defined as the stocking of a similar group of fish that was unique based on the date of stocking, the average weight of the group, the species and brood stock, and the stocking location. The cost for each individual stocking event for each year was estimated as:

$$c_j = \frac{C\ (n_j \overline{w}_j)}{\sum_{j=1}^{J} n_j \overline{w}_j} \qquad (3)$$

where:

C = annual hatchery operating cost for fiscal year;

n_j = number of fish released in stocking event *j*;

$\overline{w}_j$ = average weight of fish in stocking event *j*;

c_j = cost of fish stocked in stocking event *j*; and,

J = number of stocking events in a calendar year.

Operating budgets were based on a fiscal year (FY 1993 = 1 July 1992 through 30 June 1993). Fish stockings were based on a calendar year (CY 1993 = 1 January 1992 through 31 December 1993). The stocking cost by location (lake or group of lakes) were calculated as the sum of the c_j for a given location.

RESULTS

Brood Tables

An annual natural mortality rate of 25% was used in the rainbow trout brood tables for Birch and Quartz lakes (Tables 3 and 4). The annual natural mortality rate was only 20% in Chena Lake (Table 5). Coho salmon had an estimated annual natural mortality rate of 45% in Birch Lake (Table 6), 40% in Quartz Lake (Table 7), and 45% in Chena Lake (Table 8).

Table 3.-Brood tables for rainbow trout stocked into Birch Lake with an annual mortality rate of 0.25.

Year of Harvest	SWHS Harvest Estimate	Stocking Year	Size[a]	Year of Harvest Abundance	Age	Natural Mortality	Unavailable Due to Timing	Number Available	Proportion Cohort in Population	Angler Preference	Adjusted Population	Adjusted Proportion	Number of Cohort in Harvest
1977	1,850	1977	F	104,249	0								
		1974	F	157	3	39	0	118	0.014	1.5	177	0.014	27
		1976	C	766	2	192	0	575	0.070	1.5	862	0.070	130
		other			2	0	0	7,500	0.915	1.5	11,250	0.915	1,694
								8,192					1,850
1978	5,126	1978	F	95,079	0								
		1977	F	10,425	1	2,606	6,985	834	0.151	0.8	667	0.087	444
		1976	C	445	2	111	0	334	0.060	1.5	500	0.065	333
		other		5,806	2	1,452	0	4,355	0.789	1.5	6,532	0.848	4,349
								5,522					5,126
1979	4,190	1978	F	9,508	1	2,377	6,370	761	0.064	0.8	609	0.046	191
		1977	F	7,374	2	1,844	0	5,531	0.466	1.5	8,296	0.621	2,602
		1979	S	22,492	1	1,856	15,069	5,567	0.469	0.8	4,453	0.333	1,397
								11,858					4,190
1980	18,727	1978	F	6,940	2	1,735	0	5,205	0.176	1.5	7,808	0.246	4,607
		1977	F	2,929	3	732	0	2,196	0.074	1.5	3,295	0.104	1,944
		1980	S	31,337	1	2,585	20,996	7,756	0.262	0.8	6,205	0.196	3,661
		1979	S	19,239	2	4,810	0	14,429	0.488	1.0	14,429	0.455	8,515
								29,587					18,727
1981	21,622	1978	F	598	3	149	0	448	0.015	1.5	673	0.020	439
		1981	S	27,708	1	2,286	18,564	6,858	0.224	0.2	1,372	0.041	894
		1980	S	25,091	2	6,273	0	18,818	0.616	1.3	24,463	0.738	15,950
		1979	S	5,915	3	1,479	0	4,436	0.145	1.5	6,654	0.201	4,339
								30,560					21,622

-continued-

Table 3.-Page 2 of 4.

Year of Harvest	SWHS Harvest Estimate	Stocking Year	Size[a]	Year of Harvest Abundance	Age	Natural Mortality	Unavailable Due to Timing	Number Available	Proportion Cohort in Population	Angler Preference	Adjusted Population	Adjusted Proportion	Number of Cohort in Harvest
1982	18,385	1982	F	298,500	0								
		1982	S	26,260	1								
		1981	S	24,528	2	6,132	0	18,396	0.895	1.5	27,594	0.895	16,461
		1980	S	2,867	3	717	0	2,151	0.105	1.5	3,226	0.105	1,924
								20,546					18,385
1983	16,963	1983	F	125,218	0								
		1982	F	3,582	1	896	2,400	287	0.020	1.2	344	0.022	287
		1983	S	15,586	1	1,286	10,442	3,857	0.275	1.2	4,629	0.297	3,857
		1982	S	24,094	2	6,023	9,638	8,433	0.601	1.0	8,433	0.541	8,433
		1981	S	1,935	3	484	0	1,451	0.103	1.5	2,177	0.140	1,451
								14,028					14,028
1984	12,123	1984	F	269,963	0								
		1983	F	2,755	1	689	1,846	220	0.013	0.8	176	0.008	99
		1982	F	2,400	2	600	0	1,800	0.105	1.5	2,700	0.125	1,519
		1983	S	10,442	2	2,611	0	7,832	0.459	1.0	7,832	0.363	4,406
		1982	S	9,638	3	2,409	0	7,228	0.423	1.5	10,842	0.503	6,099
								17,080					12,123
1985	10,161	1984	F	3,779	1	945	2,532	302	0.066	0.8	242	0.037	302
		1983	F	1,967	2	492	0	1,475	0.324	1.5	2,213	0.334	1,475
		1982	F	281	3	70	0	211	0.046	1.5	316	0.048	211
		1983	S	3,426	3	857	0	2,570	0.564	1.5	3,854	0.582	2,570
								4,558					4,558

-continued-

Table 3.-Page 3 of 4.

Year of Harvest	SWHS Harvest Estimate	Stocking Year	Size[a]	Year of Harvest Abundance	Age	Natural Mortality	Unavailable Due to Timing	Number Available	Proportion Cohort in Population	Angler Preference	Adjusted Population	Adjusted Proportion	Number of Cohort in Harvest
1986	8,723	1984	F	2,532	2	633	0	1,899	0.120	1.5	2,849	0.204	1,778
		1983	F	0	3								
		1986	S	56,190	1	4,636	37,647	13,907	0.880	0.8	11,126	0.796	6,945
								15,806					8,723
1987	9,981	1984	F	121	3	30	0	91	0.002	1.5	136	0.004	36
		1987	S	18,585	1	1,533	12,452	4,600	0.121	0.8	3,680	0.099	985
		1986	S	44,610	2	11,152	0	33,457	0.877	1.0	33,457	0.898	8,959
								38,148					9,981
1988	18,390	1988	S	26,869	1	2,217	18,002	6,650	0.179	0.8	5,320	0.118	2,178
		1987	S	16,067	2	4,017	0	12,050	0.325	1.0	12,050	0.268	4,932
		1986	S	24,498	3	6,125	0	18,374	0.496	1.5	27,560	0.613	11,280
								37,074					18,390
1989	16,420	1989	S	14,150	1	1,167	9,481	3,502	0.129	0.8	2,802	0.096	1,576
		1988	S	22,475	2	5,619	0	16,856	0.619	1.0	16,856	0.578	9,484
		1987	S	7,118	3	1,779	0	5,338	0.196	1.5	8,008	0.274	4,506
		1989	C	4,045	1	506	2,023	1,517	0.056	1.0	1,517	0.052	853
								27,214					16,420
1990	15,901	1990	S	25,236	1	2,082	16,908	6,246	0.280	0.8	4,997	0.201	3,195
		1989	S	11,406	2	2,852	0	8,555	0.383	1.0	8,555	0.344	5,470
		1988	S	7,372	3	1,843	0	5,529	0.247	1.5	8,293	0.334	5,303
		1989	C	2,686	2	671	0	2,014	0.090	1.5	3,022	0.122	1,932
								22,344					15,901

-continued-

Table 3.-Page 4 of 4.

Year of Harvest	SWHS Harvest Estimate	Stocking Year	Size[a]	Year of Harvest Abundance	Age	Natural Mortality	Unavailable Due to Timing	Number Available	Proportion Cohort in Population	Angler Preference	Adjusted Population	Adjusted Proportion	Number of Cohort in Harvest
1991	17,625	1991	S	13,130	1	1,083	8,797	3,250	0.158	2.0	6,499	0.255	3,250
		1990	S	19,959	2	4,990	0	14,969	0.727	1.0	14,969	0.586	10,337
		1989	S	3,084	3	771	0	2,313	0.112	1.7	3,932	0.154	2,313
		1989	C	82	3	21	0	62	0.003	2.0	123	0.005	62
								20,594					15,961
1992	8,312	1992	S	12,786	1	1,055	8,567	3,165	0.239	1.0	3,165	0.211	1,757
		1991	S	8,797	2	2,199	0	6,598	0.498	1.0	6,598	0.441	3,662
		1990	S	4,633	3	1,158	0	3,474	0.262	1.5	5,212	0.348	2,893
								13,237					8,312
1993	11,332	1993	S	12,765	1	1,053	8,552	3,159	0.143	1.5	4,739	0.143	1,625
		1993	C	12,256	1	3,064	0	9,192	0.417	1.5	13,788	0.417	4,727
		1992	S	9,974	2	2,494	0	7,481	0.340	1.5	11,221	0.340	3,847
		1991	S	2,935	3	734	0	2,202	0.100	1.5	3,302	0.100	1,132
								22,034					11,332

[a] F = Fingerling; S = Subcatchable; C = Catchable

Table 4.-Brood tables for rainbow trout stocked into Quartz Lake with an annual mortality rate of 0.20.

Year of Harvest	SWHS Harvest Estimate	Stocking Year	Size[a]	Year of Harvest Abundance	Age	Natural Mortality	Unavailable Due to Timing	Number Available	Proportion Cohort in Population	Angler Preference	Adjusted Population	Adjusted Proportion	Number of Cohort in Harvest
1977	2,634	1977	F	110,500	0								
		1976	F	2,330	1	154	1,561	615	0.233	1.5	922	0.233	614
		1975	F	630	2	126	0	504	0.191	1.5	756	0.191	503
		1974	F	111	3	22	0	89	0.034	1.5	133	0.034	89
		1977	S	3,301	1	218	1,651	1,433	0.543	1.5	2,149	0.543	1,429
								2,640					2,634
1978	512	1978	F	0	0								
		1977	F	1,658	1	109	1,111	438	0.145	0.8	350	0.083	43
		1976	F	1,562	2	312	0	1,250	0.415	1.5	1,875	0.445	228
		1975	F	1	3								
		1977	S	1,654	2	331	0	1,323	0.439	1.5	1,985	0.471	241
								3,011					512
1979	273	1979	F	32,858	0								
		1977	F	1,506	2	301	0	1,204	0.417	1.5	1,807	0.417	114
		1976	F	1,022	3	204	0	817	0.283	1.5	1,226	0.283	77
		1975	F	1	4								
		1977	S	1,082	3	216	0	865	0.300	1.5	1,298	0.300	82
								2,888					273
1980	129	1980	F	87,559	0								
		1979	F	2,300	1	152	1,541	607	0.288	0.8	486	0.178	23
		1977	F	1,091	3	218	0	872	0.414	1.5	1,309	0.479	62
		1977	S	784	4	157	0	627	0.298	1.5	940	0.344	44
								2,107					129

-continued-

Table 4.-Page 2 of 5.

Year of Harvest	SWHS Harvest Estimate	Stocking Year	Size[a]	Year of Harvest Abundance	Age	Natural Mortality	Unavailable Due to Timing	Number Available	Proportion Cohort in Population	Angler Preference	Adjusted Population	Adjusted Proportion	Number of Cohort in Harvest
1981	1,869	1981	F	0	0								
		1980	F	6,129	1	405	4,107	1,618	0.488	0.8	1,294	0.337	629
		1979	F	2,125	2	425	0	1,700	0.512	1.5	2,550	0.663	1,240
								3,318					1,869
1982	5,003	1982	F	226,600	0								
		1981	F	0	1								
		1980	F	5,095	2	1,019	0	4,076	0.917	1.5	6,114	0.917	4,076
		1979	F	461	3	92	0	368	0.083	1.5	553	0.083	368
								4,445					4,445
1983	1,547	1983	F	233,272	0								
		1982	F	15,862	1	1,047	10,628	4,188	1.000	0.8	3,350	1	1,547
		1980	F	0	3								
								4,188					1,547
1984	5,491	1984	F	273,567	0								
		1983	F	16,329	1	1,078	10,940	4,311	0.289	0.8	3,449	0.178	978
		1982	F	13,268	2	2,654	0	10,614	0.711	1.5	15,922	0.822	4,513
								14,925					5,491
1985	12,398	1985	F	287,376	0								
		1984	F	19,150	1	1,264	12,830	5,056	0.237	0.8	4,044	0.142	1,760
		1983	F	14,274	2	2,855	0	11,419	0.535	1.5	17,128	0.601	7,453
		1982	F	6,101	3	1,220	0	4,881	0.229	1.5	7,321	0.257	3,186
								21,355					12,398

-continued-

Table 4.-Page 3 of 5.

Year of Harvest	SWHS Harvest Estimate	Stocking Year	Size[a]	Year of Harvest Abundance	Age	Natural Mortality	Unavailable Due to Timing	Number Available	Proportion Cohort in Population	Angler Preference	Adjusted Population	Adjusted Proportion	Number of Cohort in Harvest
1986	14,778	1986	F	329,865	0								
		1985	F	20,116	1	1,328	13,478	5,311	0.248	1.3	6,904	0.223	3,290
		1984	F	16,126	2	3,225	0	12,901	0.603	1.5	19,351	0.624	9,221
		1983	F	3,966	3	793	0	3,173	0.148	1.5	4,760	0.153	2,268
								21,385					14,778
1987	10,106	1987	F	407,917	0								
		1986	F	23,091	1	1,524	15,471	6,096	0.279	0.8	4,877	0.173	1,748
		1985	F	15,499	2	3,100	0	12,399	0.568	1.5	18,599	0.660	6,667
		1984	F	3,680	3	736	0	2,944	0.135	1.5	4,416	0.157	1,583
		1987	S	1,420	1	94	951	375	0.017	0.8	300	0.011	108
								21,814					10,106
1988	25,175	1988	F	150,000	0								
		1987	F	28,554	1	1,885	19,131	7,538	0.232	1.5	11,307	0.232	5,838
		1986	F	19,818	2	3,964	0	15,855	0.488	1.5	23,782	0.488	12,278
		1985	F	5,732	3	1,146	0	4,586	0.141	1.5	6,878	0.141	3,551
		1988	S	13,466	1	889	9,022	3,555	0.109	1.5	5,333	0.109	2,753
		1987	S	1,219	2	244	0	975	0.030	1.5	1,463	0.030	755
								32,509					25,175

-continued-

Table 4.-Page 4 of 5.

Year of Harvest	SWHS Harvest Estimate	Stocking Year	Size[a]	Year of Harvest Abundance	Age	Natural Mortality	Unavailable Due to Timing	Number Available	Proportion Cohort in Population	Angler Preference	Adjusted Population	Adjusted Proportion	Number of Cohort in Harvest
1989	27,356	1989	F	150,000	0								
		1988	F	10,500	1	693	7,035	2,772	0.088	1.5	4,158	0.090	2,475
		1987	F	20,832	2	4,166	0	16,666	0.529	1.5	24,998	0.544	14,879
		1986	F	3,577	3	715	0	2,861	0.091	1.5	4,292	0.093	2,555
		1989	S	4,354	1	287	2,917	1,149	0.037	0.4	460	0.010	274
		1988	S	9,824	2	1,965	0	7,860	0.250	1.5	11,789	0.257	7,017
		1987	S	220	3	44	0	176	0.006	1.5	264	0.006	157
								31,484					27,356
1990	20,847	1990	F	203,546	0								
		1989	F	10,500	1	693	7,035	2,772	0.133	1.5	4,158	0.133	2,772
		1988	F	7,332	2	1,466	0	5,866	0.282	1.5	8,799	0.282	5,866
		1987	F	1,787	3	357	0	1,429	0.069	1.5	2,144	0.069	1,429
		1990	S	5,787	1	382	3,877	1,528	0.073	1.5	2,292	0.073	1,528
		1989	S	3,793	2	759	0	3,034	0.146	1.5	4,551	0.146	3,034
		1988	S	7,702	3	1,540	0	6,162	0.296	1.5	9,243	0.296	6,162
								20,791					20,791
1991	28,238	1991	F	152,000	0								
		1990	F	14,248	1	940	9,546	3,762	0.261	1.5	5,642	0.261	3,762
		1989	F	7,035	2	1,407	0	5,628	0.390	1.5	8,442	0.390	5,628
		1988	F	0	3								
		1991	S	7,304	1	482	4,894	1,928	0.134	1.5	2,893	0.134	1,928
		1990	S	3,877	2	775	0	3,102	0.215	1.5	4,653	0.215	3,102
		1989	S	0	3								
								14,420					14,420

-continued-

Table 4.-Page 5 of 5.

Year of Harvest	SWHS Harvest Estimate	Stocking Year	Size[a]	Year of Harvest Abundance	Age	Natural Mortality	Unavailable Due to Timing	Number Available	Proportion Cohort in Population	Angler Preference	Adjusted Population	Adjusted Proportion	Number of Cohort in Harvest
1992	13,544	1992	F	400,609	0								
		1991	F	10,640	1	702	7,129	2,809	0.181	0.8	2,247	0.116	1,574
		1990	F	9,546	2	1,909	0	7,637	0.492	1.5	11,456	0.592	7,637
		1989	F	0	3								
		1992	S	4,440	1	293	2,975	1,172	0.075	0.8	938	0.048	657
		1991	S	4,894	2	979	0	3,915	0.252	1.2	4,698	0.243	3,290
		1990	S	0	3								
								15,533					13,158
1993	18,699	1993	F	420,901	0								
		1992	F	28,043	1	1,851	18,789	7,403	0.426	0.8	5,923	0.283	5,299
		1991	F	8,364	2	1,673	0	6,691	0.385	1.5	10,037	0.480	6,691
		1990	F	0	3								
		1993	S	0	1								
		1992	S	3,490	2	698	0	2,792	0.161	1.5	4,189	0.200	2,792
		1991	S	625	3	125	0	500	0.029	1.5	750	0.036	500
								17,387					15,283

[a] F = Fingerling; S = Subcatchable; C = Catchable

Table 5.-Brood tables for rainbow trout stocked into Chena Lake with an annual mortality rate of 0.25.

Year of Harvest	SWHS Harvest Estimate	Stocking Year	Size[a]	Year of Harvest Abundance	Age	Natural Mortality	Unavailable Due to Timing	Number Available	Proportion Cohort in Population	Angler Preference	Adjusted Population	Adjusted Proportion	Number of Cohort in Harvest
1982	0	1982	F	20,417	0								
		1982	S	6,421	1	530	4,302	1,589	0	0.8	1,271	1	0
								1,589					0
1983	0	1983	F	30,691	0								
		1982	F	14,904	1	1,230	9,986	3,689	0	0.8	2,951	0.358	0
		1982	S	5,891	2	1,473	0	4,418	0	1.2	5,302	0.642	0
								8,107					0
1984	12,032	1984	F	47,529	0								
		1984	S	9,290	1	766	6,224	2,299	0.143	1.4	3,219	0.134	1,618
		1983	F	3,069	1	767	2,056	246	0.015	1.5	368	0.015	185
		1982	F	13,675	2	3,419	0	10,256	0.636	1.5	15,384	0.643	7,731
		1982	S	4,418	3	1,105	0	3,314	0.206	1.5	4,971	0.208	2,498
								16,115					12,032
1985	9,990	1985	S	14,220	1	1,173	9,527	3,519	0.274	1.5	5,279	0.274	2,732
		1984	F	951	1	238	637	76	0.006	1.5	114	0.006	59
		1984	S	6,906	2	1,726	0	5,179	0.402	1.5	7,769	0.402	4,021
		1983	F	2,117	2	529	0	1,588	0.123	1.5	2,381	0.123	1,233
		1982	F	2,525	3	631	0	1,894	0.147	1.5	2,840	0.147	1,470
		1982	S	816	4	204	0	612	0.048	1.5	918	0.048	475
								12,868					9,990

-continued-

Table 5.-Page 2 of 3.

Year of Harvest	SWHS Harvest Estimate	Stocking Year	Size[a]	Year of Harvest Abundance	Age	Natural Mortality	Unavailable Due to Timing	Number Available	Proportion Cohort in Population	Angler Preference	Adjusted Population	Adjusted Proportion	Number of Cohort in Harvest
1986	7,001	1986	S	26,192	1	2,161	17,549	6,482	0.409	0.8	5,186	0.307	2,147
		1985	S	10,314	2	2,579	0	7,736	0.488	1.2	9,283	0.549	3,844
		1984	F	654	2	163	0	490	0.031	1.5	736	0.044	305
		1984	S	1,158	3	290	0	869	0.055	1.5	1,303	0.077	540
		1983	F	355	3	89	0	266	0.017	1.5	399	0.024	165
								15,844					7,001
1987	5,220	1987	C	19,316	1	2,415	9,658	7,244	0.269	1.2	8,692	0.261	1,361
		1986	S	21,884	2	5,471	0	16,413	0.609	1.2	19,695	0.591	3,083
		1985	S	3,892	3	973	0	2,919	0.108	1.5	4,378	0.131	685
		1984	F	186	3	46	0	139	0.005	1.5	209	0.006	33
		1984	S	329	4	82	0	247	0.009	1.5	370	0.011	58
								26,961					5,220
1988	9,877	1988	C	30,091	1	3,761	15,046	11,284	0.326	1.2	13,541	0.279	2,756
		1987	C	15,541	2	3,885	0	11,656	0.337	1.5	17,483	0.360	3,558
		1986	S	13,329	3	3,332	0	9,997	0.289	1.5	14,996	0.309	3,052
		1985	S	2,233	4	558	0	1,675	0.048	1.5	2,513	0.052	511
								34,612					9,877
1989	11,966	1989	C	30,481	1	3,810	15,241	11,430	0.283	1.2	13,716	0.240	2,871
		1988	C	23,574	2	5,893	0	17,680	0.438	1.5	26,521	0.464	5,552
		1987	C	8,097	3	2,024	0	6,073	0.150	1.5	9,110	0.159	1,907
		1986	S	6,945	4	1,736	0	5,209	0.129	1.5	7,813	0.137	1,636
								40,393					11,966

-continued-

Table 5.-Page 3 of 3.

Year of Harvest	SWHS Harvest Estimate	Stocking Year	Size[a]	Year of Harvest Abundance	Age	Natural Mortality	Unavailable Due to Timing	Number Available	Proportion Cohort in Population	Angler Preference	Adjusted Population	Adjusted Proportion	Number of Cohort in Harvest
1990	8,558	1990	C	31,251	1	3,906	15,626	11,719	0.280	1.2	14,063	0.238	2,034
		1989	C	23,799	2	5,950	0	17,850	0.427	1.5	26,774	0.453	3,873
		1988	C	12,129	3	3,032	0	9,096	0.218	1.5	13,645	0.231	1,974
		1987	C	4,166	4	1,042	0	3,125	0.075	1.5	4,687	0.079	678
								41,790					8,558
1991	12,196	1991	C	26,976	1	3,372	13,488	10,116	0.225	1.2	12,139	0.189	2,301
		1990	C	25,311	2	6,328	0	18,983	0.423	1.5	28,474	0.442	5,397
		1989	C	13,977	3	3,494	0	10,483	0.233	1.5	15,724	0.244	2,980
		1988	C	7,123	4	1,781	0	5,342	0.119	1.5	8,013	0.125	1,519
								44,924					12,196
1992	3,602	1992	C	10,024	1	1,253	5,012	3,759	0.099	1.2	4,511	0.083	299
		1992	S	10,367	1	855	6,946	2,566	0.067	0.8	2,053	0.038	136
		1991	C	21,303	2	5,326	0	15,978	0.419	1.5	23,966	0.442	1,591
		1990	C	13,586	3	3,397	0	10,190	0.267	1.5	15,285	0.282	1,015
		1989	C	7,503	4	1,876	0	5,627	0.148	1.5	8,441	0.156	560
								38,119					3,602
1993	5,628	1993	C	16,139	1	2,017	8,070	6,052	0.163	1.2	7,263	0.140	790
		1992	C	8,472	2	2,118	0	6,354	0.171	1.5	9,530	0.184	1,037
		1992	S	9,375	2	2,344	0	7,032	0.189	1.2	8,438	0.163	918
		1991	C	14,386	3	3,597	0	10,790	0.291	1.5	16,185	0.313	1,761
		1990	C	9,175	4	2,294	0	6,881	0.185	1.5	10,322	0.200	1,123
								37,108					5,628

[a] F = Fingerling; S = Subcatchable; C = Catchable

Table 6.-Brood tables for coho salmon stocked into Birch Lake with an annual mortality rate of 0.45.

Year of Harvest	SWHS Harvest Estimate	Stocking Year	Size[a]	Year of Harvest Abundance	Age	Natural Mortality	Unavailable Due to Timing	Number Available	Proportion Cohort in Population	Angler Preference	Adjusted Population	Adjusted Proportion	Number of Cohort in Harvest
1977	5,687	1977	F	0	0								
		1976	F	23,401	1	10,531	11,701	1,170	0.099	0.5	585	0.035	200
		1975	F	0	2								
		1974	F	23,742	3	10,684	2,374	10,684	0.901	1.5	16,026	0.965	5,487
								11,854					5,687
1978	6,354	1978	F	0	0								
		1977	F	0	1								
		1976	F	12,670	2	5,702	0	6,969	1.000	1.5	10,453	1	6,354
		1975	F	0									
								6,969					6,354
1979	132	1979	F	0	0								
		1978	F	0	1								
		1977	F	0	2								
		1976	F	615	3	277	61	277	1.000	1.5	415	1	132
								277					132
1980	0	1980	F	59,850	0								
		1979	F	0	1								
		1978	F	0	2								
		1977	F	0	3								
								0					0

-continued-

Table 6.-Page 2 of 5.

Year of Harvest	SWHS Harvest Estimate	Stocking Year	Size[a]	Year of Harvest Abundance	Age	Natural Mortality	Unavailable Due to Timing	Number Available	Proportion Cohort in Population	Angler Preference	Adjusted Population	Adjusted Proportion	Number of Cohort in Harvest
1981	2,549	1981	F	30,000	0								
		1980	F	53,117	1	23,903	26,558	2,656	1.000	0.5	1,328	1	2,549
		1979	F	0	2								
		1978	F	0	3								
								2,656					2,549
1982	6,275	1982	F	0	0								
		1981	F	26,625	1	11,981	13,313	1,331	0.083	0.5	666	0.029	184
		1980	F	26,665	2	11,999	0	14,666	0.917	1.5	21,999	0.971	6,091
		1979	F	0	3								
								15,997					6,275
1983	8,686	1983	F	0	0								
		1982	F	0	1								
		1981	F	14,459	2	6,507	0	7,953	0.673	1.5	11,929	0.673	5,848
		1980	F	8,575	3	3,859	858	3,859	0.327	1.5	5,788	0.327	2,838
								11,812					8,686
1984	6,049	1984	F	50,000	0								
		1983	F	0	1								
		1982	F	0	2								
		1981	F	2,104	3	947	210	947	1.000	1.5	1,420	1	947
								947					947

-continued-

Table 6.-Page 3 of 5.

Year of Harvest	SWHS Harvest Estimate	Stocking Year	Size[a]	Year of Harvest Abundance	Age	Natural Mortality	Unavailable Due to Timing	Number Available	Proportion Cohort in Population	Angler Preference	Adjusted Population	Adjusted Proportion	Number of Cohort in Harvest
1985	4,672	1985	F	55,539	0								
		1984	F	44,375	1	19,969	22,188	2,219	1.000	0.5	1,109	1	2,219
		1983	F	0	2								
		1982	F	0	3								
								2,219					2,219
1986	4,950	1986	F	40,000	0								
		1985	F	49,291	1	22,181	24,645	2,465	0.168	0.5	1,232	0.063	312
		1984	F	22,188	2	9,984	0	12,203	0.832	1.5	18,305	0.937	4,638
		1983	F	0	3								
								14,668					4,950
1987	6,719	1987	F	40,000	0								
		1986	F	35,500	1	15,975	17,750	1,775	0.089	0.5	888	0.032	212
		1985	F	26,798	2	12,059	0	14,739	0.740	1.5	22,108	0.787	5,286
		1984	F	7,565	3	3,404	757	3,404	0.171	1.5	5,107	0.182	1,221
								19,918					6,719
1988	5,548	1988	F	40,000	0								
		1987	F	35,500	1	15,975	17,750	1,775	0.107	0.5	888	0.038	212
		1986	F	19,313	2	8,691	0	10,622	0.638	1.5	15,933	0.687	3,810
		1985	F	9,453	3	4,254	945	4,254	0.255	1.5	6,381	0.275	1,526
								16,651					5,548

-continued-

Table 6.-Page 4 of 5.

Year of Harvest	SWHS Harvest Estimate	Stocking Year	Size[a]	Year of Harvest Abundance	Age	Natural Mortality	Unavailable Due to Timing	Number Available	Proportion Cohort in Population	Angler Preference	Adjusted Population	Adjusted Proportion	Number of Cohort in Harvest
1989	4,982	1989	F	40,000	0								
		1988	F	35,500	1	15,975	17,750	1,775	0.115	0.5	888	0.041	206
		1987	F	19,313	2	8,691	0	10,622	0.687	1.5	15,933	0.744	3,706
		1986	F	6,812	3	3,065	681	3,065	0.198	1.5	4,598	0.215	1,070
								15,462					4,982
1990	3,308	1990	F	131,000	0								
		1989	F	35,500	1	15,975	17,750	1,775	0.114	0.5	888	0.041	137
		1988	F	19,319	2	8,693	0	10,625	0.685	1.5	15,938	0.742	2,453
		1987	F	6,916	3	3,112	692	3,112	0.201	1.5	4,668	0.217	718
								15,512					3,308
1991	6,098	1991	F	40,303	0								
		1990	F	116,263	1	52,318	58,131	5,813	0.288	0.5	2,907	0.119	726
		1989	F	19,388	2	8,725	0	10,664	0.529	1.5	15,995	0.655	3,995
		1988	F	8,172	3	3,678	817	3,678	0.182	1.5	5,516	0.226	1,378
								20,154					6,098
1992	4,543	1992	F	0	0								
		1991	F	35,769	1	16,096	17,884	1,788	0.045	0.5	894	0.016	71
		1990	F	63,219	2	28,448	0	34,770	0.879	1.5	52,155	0.906	4,117
		1989	F	6,669	3	3,001	667	3,001	0.076	1.5	4,502	0.078	355
								39,560					4,543

-continued-

Table 6.-Page 5 of 5.

Year of Harvest	SWHS Harvest Estimate	Stocking Year	Size[a]	Year of Harvest Abundance	Age	Natural Mortality	Unavailable Due to Timing	Number Available	Proportion Cohort in Population	Angler Preference	Adjusted Population	Adjusted Proportion	Number of Cohort in Harvest
1993	4,041	1993	F	79,800	0								
		1993	S	8,830	1	1,987	5,916	927	0.030	0.2	185	0.004	17
		1993	KS-S	12,861	1	1,286	6,431	5,144	0.168	1.5	7,717	0.172	697
		1991	F	19,602	2	8,821	0	10,781	0.352	1.5	16,172	0.361	1,460
		1990	F	30,653	3	13,794	3,065	13,794	0.450	1.5	20,691	0.462	1,868
								30,647					4,041

[a] F = Fingerling; S = Subcatchable; C = Catchable; KS-S = Chinook salmon subcatchable.

Table 7.-Brood tables for coho salmon stocked into Quartz Lake with an annual mortality rate of 0.40.

Year of Harvest	SWHS Harvest Estimate	Stocking Year	Size[a]	Year of Harvest Abundance	Age	Natural Mortality	Unavailable Due to Timing	Number Available	Proportion Cohort in Population	Angler Preference	Adjusted Population	Adjusted Proportion	Number of Cohort in Harvest
1977	0	1977	F	197,400	0								
		1976	F	0	1								
		1975	F	0	2								
		1974	F	0	3								
								0					0
1978	14,892	1978	F	55,549	0								
		1977	F	177,660	1	71,064	88,830	17,766	1.000	0.5	8,883	1	14,892
		1976	F	0	2								
		1975	F	0	3								
								17,766					14,892
1979	34,787	1979	F	150,095	0								
		1978	F	49,994	1	19,998	24,997	4,999	0.083	0.5	2,500	0.029	1,023
		1977	F	91,704	2	36,682	0	55,022	0.917	1.5	82,534	0.971	33,764
		1976	F	0	3								
								60,022					34,787
1980	23,316	1980	F	0	0								
		1979	F	135,086	1	54,034	67,543	13,509	0	0.5	6,754	0.138	3,229
		1978	F	28,974	2	11,590	0	17,384	0	1.5	26,076	0.535	12,466
		1977	F	21,258	3	8,503	2,126	10,629	0	1.5	15,944	0.327	7,622
								41,522					23,316

-continued-

Table 7.-Page 2 of 4.

Year of Harvest	SWHS Harvest Estimate	Stocking Year	Size[a]	Year of Harvest Abundance	Age	Natural Mortality	Unavailable Due to Timing	Number Available	Proportion Cohort in Population	Angler Preference	Adjusted Population	Adjusted Proportion	Number of Cohort in Harvest
1981	50,965	1981	F	150,114	0								
		1980	F	0	1					0.5			
		1979	F	77,822	2	31,129	0	46,693	0.950	1.5	70,040	0.950	46,693
		1978	F	4,919	3	1,967	492	2,459	0.050	1.5	3,689	0.050	2,459
								49,153					49,153
1982	35,380	1982	F	0	0								
		1981	F	135,103	1	54,041	67,551	13,510	1.000	0.5	6,755	1	13,510
		1980	F	0	2								
		1979	F	0	3								
								13,510					13,510
1983	24,042	1983	F	46,543	0								
		1982	F	0	1								
		1981	F	67,551	2	27,021	0	40,531	1.000	1.5	60,796	1	24,042
		1980	F	0	3								
								40,531					24,042
1984	17,069	1984	F	155,718	0								
		1983	F	41,889	1	16,755	20,944	4,189	0.337	1.5	6,283	0.337	4,189
		1982	F	0	2								
		1981	F	16,489	3	6,596	1,649	8,244	0.663	1.5	12,367	0.663	8,244
								12,433					12,433

-continued-

Table 7.-Page 3 of 4.

Year of Harvest	SWHS Harvest Estimate	Stocking Year	Size[a]	Year of Harvest Abundance	Age	Natural Mortality	Unavailable Due to Timing	Number Available	Proportion Cohort in Population	Angler Preference	Adjusted Population	Adjusted Proportion	Number of Cohort in Harvest
1985	26,312	1985	F	149,976	0								
		1984	F	140,146	1	56,058	70,073	14,015	0.527	1.5	21,022	0.527	13,873
		1983	F	20,944	2	8,378	0	12,567	0.473	1.5	18,850	0.473	12,439
		1982	F	0	3								
								26,581					26,312
1986	16,613	1986	F	168,500	0								
		1985	F	84,811	1	33,925	42,406	8,481	0.167	0.5	4,241	0.063	1,043
		1984	F	70,215	2	28,086	0	42,129	0.831	1.5	63,194	0.936	15,546
		1983	F	127	3	51	13	64	0.001	1.5	95	0.001	23
								50,674					16,613
1987	15,449	1987	F	168,489	0								
		1986	F	95,287	1	38,115	47,643	9,529	0.181	0.5	4,764	0.068	1,058
		1985	F	49,844	2	19,937	0	29,906	0.567	1.5	44,859	0.645	9,963
		1984	F	26,583	3	10,633	2,658	13,291	0.252	1.5	19,937	0.287	4,428
								52,726					15,449
1988	19,009	1988	F	150,000	0								
		1987	F	95,281	1	38,112	47,640	9,528	0.179	0.5	4,764	0.068	1,290
		1986	F	56,114	2	22,446	0	33,668	0.633	1.5	50,503	0.719	13,671
		1985	F	19,943	3	7,977	1,994	9,972	0.188	1.5	14,957	0.213	4,049
								53,168					19,009
1989	9,593	1989	F	150,000	0								
		1988	F	84,825	1	33,930	42,413	8,483	0.163	0.5	4,241	0.061	585
		1987	F	55,879	2	22,351	0	33,527	0.645	1.5	50,291	0.723	6,939
		1986	F	19,998	3	7,999	2,000	9,999	0.192	1.5	14,998	0.216	2,069
								52,009					9,593

-continued-

Table 7.-Page 4 of 4.

Year of Harvest	SWHS Harvest Estimate	Stocking Year	Size[a]	Year of Harvest Abundance	Age	Natural Mortality	Unavailable Due to Timing	Number Available	Proportion Cohort in Population	Angler Preference	Adjusted Population	Adjusted Proportion	Number of Cohort in Harvest
1990	7,309	1990	F	150,000	0								
		1989	F	84,825	1	33,930	42,413	8,483	0.163	0.5	4,241	0.061	446
		1988	F	50,310	2	20,124	0	30,186	0.581	1.5	45,279	0.652	4,764
		1987	F	26,589	3	10,635	2,659	13,294	0.256	1.5	19,942	0.287	2,098
								51,963					7,309
1991	11,054	1991	F	151,785	0								
		1990	F	84,825	1	33,930	42,413	8,483	0.165	0.5	4,241	0.062	682
		1989	F	50,449	2	20,179	0	30,269	0.588	1.5	45,404	0.661	7,304
		1988	F	25,422	3	10,169	2,542	12,711	0.247	1.5	19,066	0.277	3,067
								51,462					11,054
1992	7,053	1992	F	0	0								
		1991	F	85,834	1	34,334	42,917	8,583	0.171	0.5	4,292	0.064	454
		1990	F	50,213	2	20,085	0	30,128	0.600	1.5	45,191	0.677	4,778
		1989	F	22,965	3	9,186	2,296	11,482	0.229	1.5	17,224	0.258	1,821
								50,193					7,053
1993	8,977	1993	F	160,600	0								
		1993	S	7,655	1	1,531	0	6,124	0.112	0.2	1,225	0.012	149
		1993	KS-S	12,568	1	1,257	6,284	5,027	0.092	1.5	7,541	0.104	934
		1992	F	0	1	0	0	0	0	0.5	0	0	0
		1991	F	51,047	2	20,419	0	30,628	0.562	1.5	45,942	0.623	5,689
		1990	F	25,349	3	10,140	2,535	12,675	0.233	1.5	19,012	0.258	2,354
								54,454					8,977

[a] **F = Fingerling; S = Subcatchable; C = Catchable; KS = Chinook salmon subcatchable.**

Table 8.-Brood tables for coho salmon stocked into Chena Lake with an annual mortality rate of 0.45.

Year of Harvest	SWHS Harvest Estimate	Stocking Year	Size[a]	Year of Harvest Abundance	Age	Natural Mortality	Unavailable Due to Timing	Number Available	Proportion Cohort in Population	Angler Preference	Adjusted Population	Adjusted Proportion	Number of Cohort in Harvest
1982	0	1982	F	27,607									
		1981	F	0	1								
		1980	F	0	2								
		1979	F	0	3								
								0					0
1983	0	1983	F	0									
		1982	F	24,501	1	11,026	12,251	1,225	1.000	0.5	613	1	0
		1981	F	0	2								
		1980	F	0	3								
								1,225					0
1984	5,036	1984	F	30,000	0								
		1983	F	0	1								
		1982	F	13,476	2	6,064	0	7,412	1.000	1.5	11,117	1	5,036
		1981	F	0	3								
								7,412					5,036
1985	9,485	1985	F	30,000	0								
		1984	F	26,625	1	11,981	13,313	1,331	0.555	0.5	666	0.293	1,331
		1983	F	0	2								
		1982	F	2,376	3	1,069	238	1,069	0.445	1.5	1,604	0.707	1,069
								2,400					2,400

-continued-

Table 8.-Page 2 of 3.

Year of Harvest	SWHS Harvest Estimate	Stocking Year	Size[a]	Year of Harvest Abundance	Age	Natural Mortality	Unavailable Due to Timing	Number Available	Proportion Cohort in Population	Angler Preference	Adjusted Population	Adjusted Proportion	Number of Cohort in Harvest
1986	1,778	1986	F	30,000	0								
		1985	F	26,625	1	11,981	13,313	1,331	0.154	0.5	666	0.057	102
		1984	F	13,313	2	5,991	0	7,322	0.846	1.5	10,983	0.943	1,676
		1983	F	0	3								
								8,653					1,778
1987	1,398	1987	F	30,000	0								
		1986	F	26,625	1	11,981	13,313	1,331	0.112	0.5	666	0.040	56
		1985	F	14,542	2	6,544	0	7,998	0.674	1.5	11,997	0.728	1,018
		1984	F	5,645	3	2,540	565	2,540	0.214	1.5	3,811	0.231	323
								11,870					1,398
1988	2,401	1988	SS,KS-F	47,885	0								
		1987	F	26,625	1	11,981	13,313	1,331	0.107	0.5	666	0.038	92
		1986	F	14,587	2	6,564	0	8,023	0.642	1.5	12,034	0.691	1,660
		1985	F	6,980	3	3,141	698	3,141	0.251	1.5	4,712	0.271	650
								12,495					2,401
1989	2,468	1989	F	15,000	0								
		1988	F	42,498	1	19,124	21,249	2,125	0.164	0.5	1,062	0.061	151
		1987	F	14,552	2	6,548	0	8,004	0.616	1.5	12,005	0.691	1,706
		1986	F	6,363	3	2,864	636	2,864	0.220	1.5	4,295	0.247	611
								12,992					2,468

-continued-

Table 8.-Page 3 of 3.

Year of Harvest	SWHS Harvest Estimate	Stocking Year	Size[a]	Year of Harvest Abundance	Age	Natural Mortality	Unavailable Due to Timing	Number Available	Proportion Cohort in Population	Angler Preference	Adjusted Population	Adjusted Proportion	Number of Cohort in Harvest
1990	2,313	1990	F	0	0								
		1989	F	13,313	1	5,991	6,656	666	0.041	0.5	333	0.014	32
		1988	F	23,223	2	10,450	0	12,773	0.785	1.5	19,159	0.807	1,866
		1987	F	6,297	3	2,834	630	2,834	0.174	1.5	4,251	0.179	414
								16,272					2,313
1991	3,058	1991	F	16,364	0								
		1990	F	0	1								
		1989	F	7,289	2	3,280	0	4,009	0.450	1.5	6,014	0.450	1,375
		1988	F	10,906	3	4,908	1,091	4,908	0.550	1.5	7,362	0.550	1,683
								8,917					3,058
1992	1,752	1992	S	10,428	1	2,346	0	8,082	0.809	0.2	1,616	0.430	754
		1991	F	14,523	1	6,535	7,262	726	0.073	0.5	363	0.097	169
		1990	F	0	2	0	0	0	0	1.5	0	0	0
		1989	F	2,634	3	1,185	263	1,185	0.119	1.5	1,778	0.473	829
								9,993					1,752
1993	1,219	1993	F	60,000	0								
		1993	KS-S	5,209	1	586	2,605	2,018	0.158	1.5	3,028	0.205	249
		1993	S	3,160	1	711	0	2,449	0.191	0.2	490	0.033	40
		1992	S	7,328	2	3,298	0	4,030	0.315	1.2	4,837	0.327	398
		1991	F	7,818	2	3,518	0	4,300	0.336	1.5	6,450	0.436	531
		1990	F	0	3								
								12,798					1,219

[a] F = Fingerling; S = Subcatchable; C = Catchable; KS-S = Chinook salmon subcatchable; SS, KS-F = Coho salmon and Chinook salmon fingerling.

Estimates of harvest and percent return to the creel by stocking cohort for rainbow trout and coho salmon are summarized in Tables 9-14. Cohorts of rainbow trout stocked as fingerlings provided the majority of their contribution to the harvest during the second year after they were stocked. Harvest of rainbow trout stocked as subcatchables and catchables was highest during the first year after stocking. The estimated percent return to the creel from cohorts of rainbow trout stocked as fingerlings was generally highest (about 5%) for Quartz Lake. The percent return to the creel from rainbow trout stocked as subcatchables was usually highest for Birch Lake. Most returns were greater than 12% but less than 40%. Usually about 20% to 70% of the rainbow trout stocked as catchables in Birch Lake and Chena Lake were harvested. Data from Chena Lake prior to 1985 were not considered because the lake was new. Sometimes survival and harvest rates for stocked fish in lakes with no other fish species were different compared to survival and harvest rates found a few years after the initial stockings. Except for a few years, harvests estimated by the brood tables were comparable to harvests reported in the SWHS (Table 15). Abundances predicted by the brood tables were greater than abundance estimated through mark-recapture experiments except for 1986 at Birch Lake and 1988 at Quartz Lake (Table 16).

The highest contribution for cohorts of coho salmon that were stocked as fingerlings was in the second year after stocking. For Chena Lake the percent return to the creel was usually more than 7% but less than 15%. For Quartz Lake the percent return has declined from slightly more than 30% to less than 10% from 1977 through 1990. There was a noticeable decrease in the annual proportion of the cohort harvested after 1984. This characteristic was not noted for rainbow trout stocked in Quartz Lake for the same period. The percent return to the creel for coho salmon stocked as fingerlings in Birch Lake has also declined from around 20% to less than 10% from 1980 through 1990. However there was no sharp decrease noted for Quartz Lake.

Cost-to-the-Creel

The estimates of the cost-to-the-creel for the various stocking cohorts of rainbow trout and coho salmon that were harvested in Birch, Quartz, and Chena lakes are summarized in Table 17. For Quartz Lake, rainbow trout stocked as fingerlings generally had a lower cost-to-the-creel than did rainbow trout that were stocked as subcatchables in the same year. In Birch Lake and Chena Lake comparisons could not be made between size cohorts within the same lake because usually only one size cohort was stocked each year. The cost-to-the-creel for rainbow trout stocked as subcatchables were usually less on average for fish from Birch Lake than from Quartz Lake. Similar comparisons could not be made between lakes for cohorts of fingerlings or catchables.

The association between stocking costs and cost-to-the-creel was not clear because sometimes similar stocking costs for similar size fish in the same lake but for different years resulted in different cost-to-the-creel. However, in general, high stocking costs were associated with high cost-to-the-creel and low stocking costs were associated with low cost-to-the-creel for different size rainbow trout and coho salmon from all three lakes.

The cost-to-the-creel for cohorts of coho salmon stocked as fingerlings were usually similar between all three lakes for the same year. But cost-to-the-creel for cohorts of coho salmon stocked as fingerlings in Quartz Lake from 1988 through 1990 were more than three times greater than the cost-to-the-creel for rainbow trout fingerlings that were stocked in Quartz Lake in the same year. However, in Birch and Chena lakes the yearly cost-to-the-creel for coho salmon

Table 9.-Total harvest, percent return to the creel, and cost-to-the-creel for rainbow trout stocked in Birch Lake.

Stocking Cohort			Harvest to Age 1			Harvest to Age 2			Harvest to Age 3			Totals			
Year	Size[a]	Number	Year	Harvest	%	Year	Harvest	%	Year	Harvest	%	Harvest	% of Stocked	Cohort Cost	Cost to Creel
1974	F	9,800	1975			1976			1977	27		27			
1977	F	104,249	1978	444	9	1979	2,602	52	1980	1,944	39	4,991	4.8		
1978	F	95,079	1979	191	4	1980	4,607	88	1981	439	8	5,237	5.5		
1982	F	298,500	1983	287	14	1984	1,519	75	1985	211	10	2,016	0.7		
1983	F	125,218	1984	99	6	1985	1,475	94	1986	0	0	1,574	1.3		
1984	F	269,963	1985	302	14	1986	1,778	84	1987	36	2	2,117	0.8		
1979	S	101,314	1979	1,397	10	1980	8,515	60	1981	4,339	30	14,250	14.1		
1980	S	55,074	1980	3,661	17	1981	15,950	74	1982	1,924	9	21,536	39.1		
1981	S	50,654	1981	894	5	1982	16,461	88	1983	1,451	8	18,806	37.1		
1982	S	97,261	1982	0	0	1983	8,433	58	1984	6,099	42	14,532	14.9		
1983	S	19,482	1983	3,857	36	1984	4,406	41	1985	2,570	24	10,833	55.6		
1986	S	83,368	1986	6,945	26	1987	8,959	33	1988	11,280	41	27,184	32.6	$69,402	$2.55
1987	S	34,039	1987	985	9	1988	4,932	47	1989	4,506	43	10,423	30.6	$34,395	$3.30
1988	S	54,723	1988	2,178	13	1989	9,484	56	1990	5,303	31	16,965	31.0	$73,296	$4.32
1989	S	50,000	1989	1,576	17	1990	5,470	58	1991	2,313	25	9,360	18.7	$23,287	$2.49
1990	S	48,345	1990	3,195	19	1991	10,337	63	1992	2,893	18	16,425	34.0	$16,730	$1.02
1991	S	25,153	1991	3,250	30	1992	3,662	34	1993	3,847	16	10,759	42.8	$13,380	$1.24
1992	S	24,494	1992	1,757		1993	4,727					6,484			
1993	S	15,956	1993	1,625								1,625			
1976	C	766	1976			1977	130		1978	333		463			
1989	C	4,045	1989	853	30	1990	1,932	68	1991	62	2	2,847	70.4	$6,781	$2.38
1993	C	12,256													

[a] F = Fingerling; S = Subcatchable; C = Catchable

Table 10.-Total harvest, percent return to the creel, and cost-to-the-creel for rainbow trout stocked in Quartz Lake.

Stocking Cohort			Harvest to Age 1			Harvest to Age 2			Harvest to Age 3			Totals			
Year	Size[a]	Number	Year	Harvest	%	Year	Harvest	%	Year	Harvest	%	Harvest	% of Stocked	Cohort Cost	Cost to Creel
1974	F	185,100							1977	89		89			
1975	F	209,900				1977	503		1978	0		503			
1976	F	155,300	1977	614	67	1978	228	25	1979	77	8	919	0.6		
1977	F	110,500	1978	43	20	1979	114	52	1980	62	28	218	0.2		
1979	F	32,858	1980	23	1	1981	1,240	76	1982	368	23	1,631	5.0		
1980	F	87,559	1981	629	13	1982	4,076	87	1983	0	0	4,706	5.4		
1982	F	226,600	1983	1,547	17	1984	4,513	49	1985	3,186	34	9,246	4.1		
1983	F	233,272	1984	978	9	1985	7,453	70	1986	2,268	21	10,698	4.6		
1984	F	273,567	1985	1,760	14	1986	9,221	73	1987	1,583	13	12,563	4.6		
1985	F	287,376	1986	3,290	24	1987	6,667	49	1988	3,551	26	13,508	4.7		
1986	F	329,865	1987	1,748	11	1988	12,278	74	1989	2,555	15	16,581	5.0	$21,824	$1.32
1987	F	407,917	1988	5,838	26	1989	14,879	67	1990	1,429	6	22,146	5.4	$52,626	$2.38
1988	F	150,000	1989	2,475	30	1990	5,866	70	1991	0		8,341	5.6	$7,485	$0.90
1989	F	150,000	1990	2,772		1991	5,628		1992	0		8,400	5.6	$5,174	$0.45
1990	F	203,546	1991	3,762		1992	7,637		1993	0		11,399	5.6	$4,651	$0.56
1991	F	152,000	1992	1,574		1993	6,691					8,265			
1992	F	400,609	1993	5,299								5,299			
1993	F	420,901													
1977	S	3,301	1977	1,429	79	1978	241	13	1979	129	7	1,800	54.5		
1987	S	10,000	1987	108	11	1988	755	74	1989	157	15	1,020	10.2	$10,567	$0.66
1988	S	48,094	1988	2,753	17	1989	7,017	44	1990	6,162	39	15,932	33.1	$61,813	$18.69
1989	S	47,003	1989	274	8	1990	3,034	92	1991	0		3,308	7.0	$34,026	$7.35
1990	S	33,843	1990	1,528	33	1991	3,102	67	1992	0		4,630	13.7	$11,712	$2.05
1991	S	42,716	1991	1,928	34	1992	3,290	57	1993	500	9	5,719	13.4	$22,035	$6.39
1992	S	25,967	1992	657		1993	2,792					3,449			
1993	S	0	1993	0											

[a] F = Fingerling; S = Subcatchable; C = Catchable

Table 11.-Total harvest, percent return to the creel, and cost-to-the-creel for rainbow trout stocked in Chena Lake.

Stocking Cohort			Harvest to Age 1			Harvest to Age 2			Harvest to Age 3			Totals			
Year	Size[a]	Number	Year	Harvest	%	Year	Harvest	%	Year	Harvest	%	Harvest	% of Stocked	Cohort Cost	Cost to Creel
1982	F	20,417	1983	0		1984	185	4	1985	4,021	96	4,206	20.6		
1983	F	30,691	1984	1,618	29	1985	59	1	1986	3,844	70	5,521	18.0		
1984	F	47,529	1985	2,732	44	1986	2,147	34	1987	1,361	22	6,241	13.1		
1982	S	7,134	1982	0		1983	0		1984	2,498	100	2,498	35.0		
1984	S	18,579	1984	7,731	83	1985	1,470	16	1986	165	2	9,367	50.4		
1985	S	15,800	1985	1,233	50	1986	540	22	1987	685	28	2,457	15.6		
1986	S	29,102	1986	305	4	1987	3,083	44	1988	3,558	51	6,946	23.9	$49,400	$7.11
1992	S	10,367	1992	136		1993	918					1,054			
1987	C	19,316	1987	58	3	1988	511	23	1989	1,636	74	2,205	11.4	$26,769	$12.14
1988	C	30,091	1988	3,052	44	1989	1,907	28	1990	1,974	28	6,932	23.0	$50,791	$7.33
1989	C	30,481	1989	5,552	45	1990	3,873	31	1991	2,980	24	12,405	40.7	$42,836	$3.45
1990	C	31,251	1990	2,034	24	1991	5,397	64	1992	1,015	12	8,445	27.0	$47,078	$5.57
1991	C	26,976	1991	2,301	41	1992	1,591	28	1993	1,761	31	5,652	21.0	$63,765	$11.28
1992	C	10,024	1992	299		1993	1,037					1,336			
1993	C	16,139	1993	790								790			

[a] F = Fingerling; S = Subcatchable; C = Catchable

Table 12.-Total harvest, percent return to the creel, and cost-to-the-creel for coho salmon stocked in Birch Lake.

Stocking Cohort			Harvest to Age 1			Harvest to Age 2			Harvest to Age 3			Totals			
Year	Size[a]	Number	Year	Harvest	%	Year	Harvest	%	Year	Harvest	%	Harvest	% of Stocked	Cohort Cost	Cost to Creel
1974	F	55,700	1975			1976			1977	5,487		5,487			
1975	F	95,000	1976			1977	0		1978	0		0			
1976	F	54,900	1977	200	3	1978	6,354	95	1979	132	2	6,686	12.2		
1980	F	59,850	1981	2,549	22	1982	6,091	53	1983	2,838	25	11,477	19.2		
1981	F	30,000	1982	184	3	1983	5,848	84	1984	947	14	6,980	23.3		
1984	F	50,000	1985	2,219	27	1986	4,638	57	1987	1,221	15	8,077	16.2		
1985	F	55,539	1986	312	4	1987	5,286	74	1988	1,526	21	7,124	12.8		
1986	F	40,000	1987	212	4	1988	3,810	75	1989	1,070	21	5,092	12.7	$6,666	$1.31
1987	F	40,000	1988	212	5	1989	3,706	80	1990	718	15	4,637	11.6	$7,293	$1.57
1988	F	40,000	1989	206	5	1990	2,453	61	1991	1,378	34	4,037	10.1	$6,782	$1.68
1989	F	40,000	1990	137	3	1991	3,995	89	1992	355	8	4,486	11.2	$4,875	$1.09
1990	F	131,000	1991	726	11	1992	4,117	61	1993	1,868	28	6,711	5.1	$22,759	$3.39
1991	F	40,303	1992	71		1993	1,460					1,530			
1992	F	0	1993	0								0			
1993	F	79,800										0			
1993	S	8,830	1993	17								17			
1993	C	12,861	1993	697								697			

[a] F = Fingerling; S = Subcatchable; C = Catchable

Table 13.-Total harvest, percent return to the creel, and cost-to-the-creel for coho salmon stocked in Quartz Lake.

Stocking Cohort			Harvest to Age 1			Harvest to Age 2			Harvest to Age 3			Totals			
Year	Size[a]	Number	Year	Harvest	%	Year	Harvest	%	Year	Harvest	%	Harvest	% of Stocked	Cohort Cost	Cost to Creel
1977	F	197,400	1978	14,892	26	1979	33,764	60	1980	7,622	14	56,278	28.5		
1978	F	55,549	1979	1,023	6	1980	12,466	78	1981	2,459	15	15,948	28.7		
1979	F	150,095	1980	3,229	6	1981	46,693	94	1982	0	0	49,922	33.3		
1981	F	150,114	1982	13,510	30	1983	24,042	52	1984	8,244	18	45,797	30.5		
1983	F	46,543	1984	4,189	25	1985	12,439	75	1986	23	0	16,652	35.8		
1984	F	155,718	1985	13,873	41	1986	15,546	46	1987	4,428	13	33,847	21.7		
1985	F	149,976	1986	1,043	7	1987	9,963	66	1988	4,049	27	15,055	10.0		
1986	F	168,500	1987	1,058	6	1988	13,671	81	1989	2,069	12	16,798	10.0	$28,082	$1.67
1987	F	168,489	1988	1,290	12	1989	6,939	67	1990	2,098	20	10,326	6.1	$22,131	$2.14
1988	F	150,000	1989	585	7	1990	4,764	57	1991	3,067	36	8,417	5.6	$25,892	$3.08
1989	F	150,000	1990	446	5	1991	7,304	76	1992	1,821	19	9,572	6.4	$17,457	$1.82
1990	F	150,000	1991	682	9	1992	4,778	61	1993	2,354	30	7,815	5.2	$26,060	$3.33
1991	F	151,785	1992	454		1993	5,689					6,143			
1992	F	0	1993	0								0			
1993	F	160,600										0			
1993	S	7,655													
1993	C	12,568	1993	934								934	7.4		

[a] F = Fingerling; S = Subcatchable; C = Catchable

Table 14.-Total harvest, percent return to the creel, and cost-to-the-creel for coho salmon stocked in Chena Lake.

Stocking Cohort			Harvest to Age 1			Harvest to Age 2			Harvest to Age 3			Totals			
Year	Size[a]	Number	Year	Harvest	%	Year	Harvest	%	Year	Harvest	%	Harvest	% of Stocked	Cohort Cost	Cost to Creel
1982	F	27,607	1983	0		1984	5,036		1985	1,069		6,105			
1984	F	30,000	1985	1,331	40	1986	1,676	50	1987	323	10	3,331	11.1		
1985	F	30,000	1986	102	6	1987	1,018	58	1988	650	37	1,769	5.9		
1986	F	30,000	1987	56	2	1988	1,660	71	1989	611	26	2,327	7.8	$4,811	$2.07
1987	F	30,000	1988	92	4	1989	1,706	77	1990	414	19	2,212	7.4	$5,875	$2.66
1988	F	47,885	1989	151	4	1990	1,866	50	1991	1,683	45	3,701	7.7	$2,589	$0.70
1989	F	15,000	1990	32	1	1991	1,375	61	1992	829		2,236	14.9	$1,742	$0.78
1990	F	0	1991	0		1992	0		1993	0		0			
1991	F	16,364	1992	169	24	1993	531					1,285	7.9		
1993	F	60,000	1993									0			
1992	S	10,428	1992	754		1993	398					568	5.4	$18,384	
1993	S	3,160	1993	40											
1993	C	5,209	1993	249								249	4.8		

[a] F = Fingerling; S = Subcatchable; C = Catchable

Table 15.-Comparison of harvest estimates between Alaska Statewide Harvest Survey and brood tables.

RAINBOW TROUT									
	Birch Lake			Quartz Lake			Chena Lake		
Year	SWHS	Brood	D[a]	SWHS	Brood	D[a]	SWHS	Brood	D[a]
1977	1,850	1,850	0	2,634	2,634	0			
1978	5,126	5,126	0	512	512	0			
1979	4,190	4,190	0	273	273	0			
1980	18,727	18,727	0	129	129	0			
1981	21,622	21,622	0	1,869	1,869	0			
1982	18,385	18,385	0	5,003	4,445	558			
1983	16,963	14,028	2,935	1,547	1,547	0			
1984	12,123	12,123	0	5,491	5,491	0	12,032	12,032	0
1985	10,161	4,558	5,603	12,398	12,398	0	9,990	9,990	0
1986	8,723	8,723	0	14,778	14,778	0	7001	7,001	0
1987	9,981	9,981	0	10,106	10,106	0	5,220	5,220	0
1988	18,390	18,390	0	25,175	25,175	0	9,877	9,877	0
1989	16,420	16,420	0	27,356	27,356	0	11,966	11,966	0
1990	15,901	15,901	0	20,847	20,230	617	8,558	8,558	0
1991	17,625	17,625	0	28,238	14,420	13,818	12,196	12,196	0
1992	8,312	8,312	0	13,544	13,158	386	3,602	3,602	0
1993	11,332	11,332	0	18,699	15,283	3,416	5,628	5,628	0

-continued-

Table 15.-Page 2 of 2.

COHO SALMON									
	Birch Lake			Quartz Lake			Chena Lake		
Year	SWHS	Brood	D[a]	SWHS	Brood	D[a]	SWHS	Brood	D[a]
1977	5,687	5,687	0	0	0	0			
1978	6,354	6,354	0	14,892	14,892	0			
1979	132	132	0	34,787	34,787	0			
1980	0	0	0	23,316	23,316	0			
1981	2,549	2,549	0	50,965	49,153	1,812			
1982	6,275	6,275	0	35,380	13,510	21,870			
1983	8,686	8,686	0	24,042	24,042	0			
1984	6,049	947	5,102	17,069	12,433	4,636	5,036	5,036	0
1985	4,672	2,219	2,453	26,312	26,312	0	9,485	2,400	7,085
1986	4,950	4,950	0	16,613	16,613	0	1,778	1,778	0
1987	6,719	6,719	0	15,449	15,449	0	1,398	1,398	0
1988	5,548	5,548	0	19,009	19,009	0	2,401	2,401	0
1989	4,982	4,982	0	9,593	9,593	0	2,468	2,468	0
1990	3,308	3,308	0	7,309	7,309	0	2,313	2,313	0
1991	6,098	6,098	0	11,054	11,054	0	3,058	3,058	0
1992	4,543	4,543	0	7,053	7,053	0	1,752	1,752	0
1993	4,041	4,041	0	8,977	8,977	0	1,219	1,219	0

[a] D is the difference between estimates from the SWHS and brood tables.

Table 16.-Comparison of abundance estimates between brood tables and mark-recapture experiments for rainbow trout stocked in Birch and Quartz lakes.

	BIRCH LAKE			QUARTZ LAKE		
Year	Brood	M-R	SE	Brood	M-R	SE
1986	15,806	58,269	2,404	21,385	10,497	2,649
1987	38,148	26,556	4,791	21,814	9,489	455
1988	37,074	25,766	2,858	32,509	43,251	5,320
1989	27,214	19,551	2,019	31,484	24,713	3,273

Table 17.-Cost-to-the-creel by stocking cohort for rainbow trout and coho salmon harvested from Birch, Quartz, and Chena lakes.

	Birch Lake		Quartz Lake		Chena Lake	
Year	Stocking Cost	Cost to Creel	Stocking Cost	Cost to Creel	Stocking Cost	Cost to Creel
Rainbow Trout						
Fingerling:						
1986			$21,824	$1.32		
1987			$52,626	$2.38		
1988			$7,485	$0.90		
1989			$5,174	$0.45		
1990			$4,651	$0.56		
Subcatchable:						
1986	$69,402	$2.55	$10,567	$0.66	$49,400	$7.11
1987	$34,395	$3.30	$61,813	$18.69		
1988	$73,296	$4.32	$34,026	$7.35		
1989	$23,287	$2.49	$11,712	$2.05		
1990	$16,730	$1.02	$22,035	$6.39		
1991	$13,380	$1.24				
Catchable:						
1986						
1987					$26,769	$12.14
1988					$50,791	$7.33
1989	$6,781	$2.38			$42,836	$3.45
1990					$47,078	$5.57
1991					$63,765	$11.28
Coho Salmon						
Fingerling:						
1986	$6,666	$1.31	$28,082	$1.67	$4,811	$2.07
1987	$7,293	$1.57	$22,131	$2.14	$5,875	$2.66
1988	$6,782	$1.68	$25,892	$3.08	$2,589	$0.70
1989	$4,875	$1.09	$17,457	$1.82	$1,742	$0.78
1990	$22,759	$3.39	$26,060	$3.33		

stocked as fingerlings were usually similar to or significantly less than the cost-to-the-creel for cohorts of rainbow trout that were stocked as subcatchables or catchables.

DISCUSSION

The construction of the brood tables and the estimation of cost-to-the-creel rely on data collected over several years from experiments that were not designed to estimate annual survival rates of different cohorts of rainbow trout and coho salmon through time or to estimate the proportion of a cohort harvested. Instead, the proportion of cohorts harvested were calculated using survival rates for different cohorts to a catchable size, estimates of annual harvest for all cohorts combined, ancillary data collected during various projects, and making educated guesses about how survival rates varied through time. These generalizations and assumptions were made in order to construct these tables and were based on the best information available.

Some of the calculations, such as the proportion of a cohort harvested, may be verified in the future by sampling the harvest for cohort composition (catch sampling). If the cohort composition of the catch can be estimated then survival rates which are more difficult to estimate would not be required. Estimates of cohort composition along with estimates of total harvest by species and stocking cost would provide all the necessary information to complete the brood tables.

Brood Tables

While there was not complete agreement between the brood tables and the five sources of information, the estimates were comparable for most situations. The largest discrepancies were between abundance estimates from the brood tables and those from mark-recapture experiments. Part of this discrepancy could be attributed to biased estimates of abundance from mark-recapture experiments and using an average to estimate annual natural mortality rates. Mark-recapture experiments require that several assumptions not be violated during an experiment. If any one of these assumptions were violated then the estimates of abundance would be biased (Ricker 1975). Average annual natural mortality rates were used in the brood tables which in some years probably resulted in biased estimates.

The numbers of fish estimated to be available to anglers in the brood tables were often much higher than what was actually harvested. Either estimates of natural mortality rates for the cohorts were too low or the fish were not harvested for some reason.

The difference noted in the annual proportion of the cohorts of coho salmon that were harvested in Quartz Lake before and after 1984 may be caused by a change in brood stock, size of the fish when stocked, or increased stockings of rainbow trout. Around 1984, the brood stocks and hatcheries for coho salmon production changed more than once (Appendix A). Any of these factors (or some combination of them) may have resulted in decreased survival of the coho salmon after 1984.

Cost-to-the-Creel

Since these are mainly consumptive fisheries, an appropriate method to evaluate them is by using cost-to-the-creel as opposed to survival or cost to a certain size or age. For Quartz Lake the cost-to-the-creel for rainbow trout was lowest for fish stocked as fingerlings. Therefore, to keep stocking costs low, catchable rainbow trout should not be stocked in Quartz Lake. The cost-to-the-creel for the different size cohorts of rainbow trout stocked in Birch Lake and Chena Lake

were not estimated because stocking costs were not calculated for stockings before 1986. Since 1986 usually only one size cohort was stocked in Birch Lake and Chena Lake so comparisons of cost-to-the-creel for different size cohorts could not be made. However, the present stocking methods for Birch Lake and Chena Lake were based on past evaluations (Doxey 1991) and calculations of cost-per-fish that survived to a catchable size (Appendix D). We found that for rainbow trout stocked in Birch Lake the cost-per-survivor to a catchable size (~180 mm) was lower for fish stocked as subcatchables than for fish that were stocked as fingerlings. Subcatchable rainbow trout had the lowest cost-per-survivor to a catchable size in Chena Lake. However, we stock catchable rainbow trout because the subcatchables grew too slowly and not many attained a large size (>300 mm). For each of these three lakes a different size cohort (fingerling, subcatchable, or catchable) gave the best results. This implies that different size fish should be stocked in each lake to keep costs low. However, this may not be the case if we consider stocking one size cohort in all three lakes as was done with coho salmon. By stocking one size cohort we may be able to reduce the overall cost-to-the-creel for all three lakes combined. The stocking of single or multiple size cohorts are different options that need to be investigated to determine which option yields the best result.

The brood tables are models of the fisheries and are useful to understanding the relation between the different factors that determine the cost-to-the-creel. These factors include the number and size of fish stocked in a cohort, the cost-per-kilogram for the hatchery to produce and stock fish, and the proportion of the cohort that is harvested. Some factors such as the number and size of fish that are stocked are more easily manipulated than are others such as harvest which depend on angler participation. Other factors such as the size of the fish at the time of stocking influence the cost-to-the-creel by affecting mortality rates, stocking costs, and ultimately the number of fish available for harvest.

ASSESSMENT OF FISHERY MANAGEMENT OBJECTIVES

METHODS

Fishery management objectives were obtained from the FMPs for Birch, Quartz, Chena, and Harding lakes (ADF&G 1993). The number of annual DF and the total catch of game fish from each lake were obtained from the SWHS to estimate sport fishing participation and harvests in Alaska (Mills 1980-1994). For Harding Lake and Piledriver Slough the DF reported in the SWHS were divided by two because these locations have populations of wild game fish and we arbitrarily assumed that at least one-half of the fishing effort was attributed to wild fish. The small lakes included unnamed lakes that were grouped in a category called "other lakes". Some of these "other lakes" had stocked game fish, others had only wild fish, and some had both. Because not all effort in the "other lakes" was on stocked populations of game fish, the effort for these lakes was apportioned by the proportion of stocked fish in the harvest for these lakes (Table 18). All rainbow trout, coho salmon, chinook salmon, Arctic char, and Arctic grayling were considered to have come from stocked populations. Fish that were listed as either Arctic char or Dolly Varden in the SWHS were considered to have been Arctic char. All other harvested fish were considered wild.

To illustrate the quantity of fish that were produced and stocked we report the total weight by species. The number of fish that were produced and stocked is often misleading because a large

Table 18.-Portion of total effort attributed to stocked game fish in Tanana Valley lakes that were classified as "other lakes" in the Alaska Statewide Harvest Survey.

	Number of Days Fished (DF)			
Year	All Small Lakes	"Other Lakes"	Adjustment Factor[a]	Adjusted DF
1986	3,978	719	0.49	3,612
1987	8,777	887	0.65	8,466
1988	16,189	1,346	0.61	15,662
1989	15,432	1,564	0.63	14,854
1990	16,479	3,663	0.51	14,686
1991	16,758	1,185	0.74	16,449
1992	10,578	NA[b]		
1993	23,950	3,576	0.60	22,516

[a] The adjustment factor for DF was calculated from harvest data for "Other Lakes". The adjustment factor is the number of stocked fish harvested divided by the total (stocked and wild) number of fish harvested from "Other Lakes". The adjusted DF was calculated using:

$$(\text{All Small Lakes} - \text{"Other Lakes"}) + \text{"Other Lakes"} \times \text{Adjustment Factor}$$

[b] The number of days fished at "Other Lakes" in 1992 was not available for this report.

number of small fish or a small number of large fish may represent the same biomass but the numbers of fish are very different.

RESULTS

Annual fishery statistics for DF by location and total harvest and stocking costs are summarized from 1977 through 1993 in Appendix E. Stocking costs by species and location are summarized from 1986 through 1994 in Table 19. Hatchery operation costs, total weight of fish produced, and cost per kilogram of fish produced are summarized in Table 20. Data file listings are summarized in Appendix F.

The annual total DF for stocked waters in the Tanana Valley have generally increased since 1977 (Figure 3). However, in 1991 and 1992 the total number of DF decreased to the lowest level in 6 years. In 1993, the level of DF increased but was still below the levels attained in 1988 through 1990. A similar trend over the same period was seen in the level of DF expended on wild stocks in the Tanana Valley. We could not explain why the level of DF declined so dramatically in the Tanana Valley, especially when the number of DF increased for other regions in the state (Mills 1994).

The annual total cost of the stocking program has generally increased since 1986 and reached its highest cost in 1992 (Figure 12). In 1993 and 1994 the total cost decreased precipitously to its lowest level since 1986.

Cost and Weight by Species

Generally, rainbow trout and Arctic char have comprised most of the annual stocking costs in the Tanana Valley (Figure 13). These two species comprised 75%-96% of the total annual stocking costs from 1988 through 1994. For the same period, in terms of total weight of fish produced and stocked, rainbow trout and Arctic char made up 74% to 92% of the total annual stockings (Figure 14). From 1988 through 1994 the annual stocking cost of Arctic char exceeded that for rainbow trout four of the seven years. However, the total weight of Arctic char that was stocked annually was greater in only two of the seven years. The higher annual stocking cost for Arctic char was partly due to a higher cost per kilogram for their production compared to that for rainbow trout. Arctic char were produced at Clear Air Force Base Hatchery which had the highest cost per kilogram for fish production (Table 20).

In 1992 the total weight of Arctic char production was about 52% of the total production weight. Since 1992 the weight of Arctic char production has decreased as a result of management decisions to end research in Arctic char rearing and stocking methods and to reallocate hatchery resources to the production of other species. In 1994 Arctic char stocking was about 22% (by weight) of the total weight of all stockings. Arctic char stockings should stabilize at around 20% (by weight) of all stockings in the Tanana Valley in 1995 and 1996.

More rainbow trout were usually stocked annually in the Tanana Valley than any other species (35% to 77% by weight; Figure 14) and rainbow trout had averaged about $177,000 or 36% of the total annual stocking costs since 1989 (Figure 13). So many rainbow trout (by weight) were stocked in the Tanana Valley because the species was able to provide fisheries in the diverse habitats found through out the valley and were popular with anglers.

The other species, Arctic grayling, coho salmon, lake trout, and chinook salmon, together comprised less than one-half of the remaining annual stocking costs. Some of these species, such

Table 19.-Summary of stocking costs and cost-per-day of fishing by location and stocking costs and total weight of fish stocked by species in the Tanana Valley, 1986-1994.

Cost by Location:

Location	1986	1987	1988	1989	1990	1991	1992	1993	1994
Birch Lake	$76,068	$41,688	$80,078	$34,942	$39,489	$26,636	$42,456	$70,368	$52,777
Quartz Lake	$49,906	$85,323	$95,190	$56,657	$42,422	$59,093	$32,025	$45,706	$29,026
Chena Lake	$54,346	$32,644	$57,113	$54,904	$47,078	$105,007	$63,045	$60,480	$37,755
Piledriver Slough	$0	$35,256	$69,055	$45,261	$33,821	$43,029	$67,634	$91,726	$42,985
Harding Lake	$70,962	$107,405	$74,360	$182,030	$356,230	$282,565	$270,491	$29,937	$15,555
Small Lake	$22,873	$50,744	$58,373	$56,075	$6,090	$63,623	$129,572	$213,291	$114,574
Total	$274,155	$353,060	$434,169	$429,868	$525,129	$579,953	$605,222	$511,508	$292,672

Cost-per-day of fishing by Location:

Location	1986	1987	1988	1989	1990	1991	1992	1993	1994
Birch Lake	$7.63	$2.71	$5.13	$2.45	$2.54	$1.92	$4.22	$6.74	
Quartz Lake	$2.70	$4.18	$4.91	$3.10	$2.15	$3.82	$2.37	$2.59	
Chena Lake	$6.14	$3.45	$6.07	$3.39	$3.66	$11.12	$10.50	$9.07	
Piledriver Slough		$5.32	$5.67	$3.98	$2.44	$4.86	$9.94	$10.63	
Harding Lake	$137.52	$83.83	$91.35	$147.54	$182.92	$109.63	$106.74	$12.26	
Small Lake	$6.33	$5.99	$3.73	$3.78	$0.41	$3.87	$12.00	$9.47	
Total	$6.62	$5.73	$5.94	$5.64	$6.68	$8.70	$12.18	$7.49	

Table 19.-Page 2 of 2.

Cost by Species:

Species	1986	1987	1988	1989	1990	1991	1992	1993	1994
Rainbow trout	$163,334	$216,446	$305,886	$171,852	$157,927	$192,710	$191,091	$204,489	$143,541
Arctic char	$2,258	$676	$56,021	$185,236	$262,698	$343,500	$368,423	$199,621	$72,128
Arctic grayling	$8,449	$9,378	$8,205	$2,426	$12,875	$28,282	$20,528	$21,987	$17,175
Coho salmon	$43,975	$46,762	$41,901	$34,359	$51,059	$10,904	$25,180	$43,085	$23,142
Chinook salmon	$8,150	$13,622	$6,392	$0	$0	$0	$0	$42,326	$21,850
Sheefish	$47,989	$66,178	$458	$3,949	$3,272	$0	$0	$0	$0
Sockeye salmon	$0	$0	$6,226	$6,445	$11,323	$0	$0	$0	$0
Lake trout	$0	$0	$9,080	$25,601	$25,975	$4,557	$0	$0	$14,835
Total	$274,155	$353,060	$434,169	$429,868	$525,129	$579,953	$605,222	$511,508	$292,672

Weight by Species:

Species	1986	1987	1988	1989	1990	1991	1992	1993	1994
Rainbow trout	4,962	8,050	9,698	8,885	10,450	8,296	11,190	10,006	6,552
Arctic char	54	18	1,100	6,445	3,429	12,356	13,334	7,068	2,724
Arctic grayling	201	249	161	84	168	1,017	743	779	649
Coho salmon	1,048	1,244	823	1,195	794	211	311	544	874
Chinook salmon	325	362	485	0	0	0	0	2,071	997
Sheefish	1,143	1,760	9	137	43	0	0	0	0
Sockeye salmon	0	0	78	82	145	0	0	0	0
Lake trout	0	0	178	891	339	164	0	0	560
Total	7,733	11,685	12,533	17,720	15,367	22,044	25,578	20,468	12,356

Table 20.-Summary of operational costs, total weight of fish produced, and cost per kilogram of fish produced at various hatcheries, 1986-1994.

Hatchery	Year	Fiscal Year Operation Cost	Calendar Year Total Weight (kg)	Cost per kg
Clear AFB:	1986	$334,000	7,956	$41.98
	1987	$357,900	9,521	$37.59
	1988	$408,000	8,013	$50.92
	1989	$393,000	13,673	$28.74
	1990	$412,000	5,377	$76.62
	1991	$412,000	14,820	$27.80
	1992	$432,331	15,647	$27.63
	1993	$453,126	16,044	$28.24
	1994	$457,863	17,290	$26.48
Ft. Richardson:	1986	$914,000	36,483	$25.05
	1987	$908,000	13,160	$69.00
	1988	$810,000	43,237	$18.73
	1989	$877,000	58,544	$14.98
	1990	$909,000	60,151	$15.11
	1991	$1,121,000	48,259	$23.23
	1992	$1,203,930	70,502	$17.08
	1993	$1,135,601	55,568	$20.44
	1994	$1,201,619	54,848	$21.91
Elmendorf AFB:	1986	$449,000	14,956	$30.02
	1987	$467,000	40,474	$11.54
	1988	$475,000	36,031	$13.18
	1989	$482,000	30,279	$15.92
	1990	$490,000	28,487	$17.20
	1991	$540,000	30,172	$17.90
	1992	$554,808	31,248	$17.75
	1993	$539,025	31,013	$17.38
	1994	$542,793	31,887	$17.02
Gulkana:	1986	$217,000	3,679	$58.98
	1987	$267,000	3,338	$79.98
	1988	$265,000	3,340	$79.34
	1989	$323,000	4,130	$78.21
	1990	$325,000	4,157	$78.17

-continued-

Table 20.-Page 2 of 2.

Hatchery	Year	Fiscal Year Operation Cost	Calendar Year Total Weight (kg)	Cost per kg
Big Lake:	1986	$395,000	5,671	$69.65
	1987	$368,000	8,449	$43.56
	1988	$388,000	13,201	$29.39
	1989	$398,000	3,553	$112.03
	1990	$405,000	6,294	$64.34
	1991	$420,000	8,112	$51.78
	1992	$364,935	3,726	$97.94
	1993	$375,344	4,743	$79.14

Data from: Recreational Fishery Program Maintenance of Effort. Alaska Department of Fish and Game, Commercial Fisheries, Management and Development Division, P.O. Box 25526, Juneau, Alaska 99802-5526.

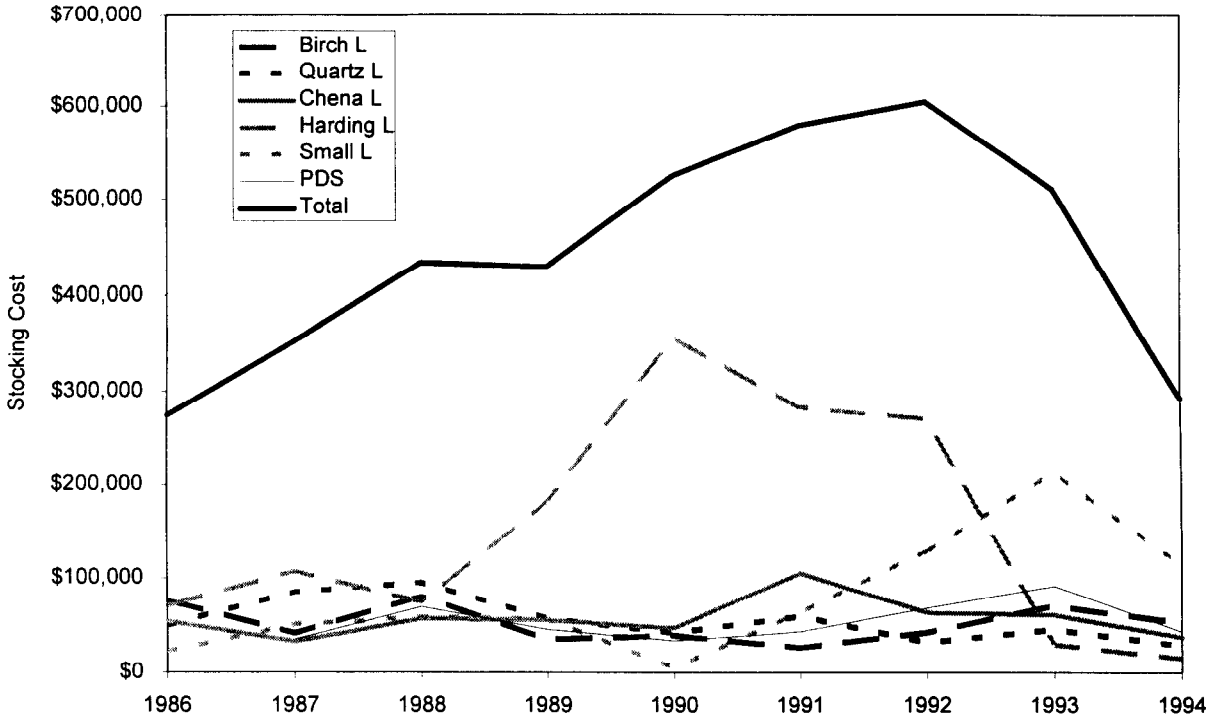

Figure 12.-Stocking costs for the major locations in the Tanana Valley.

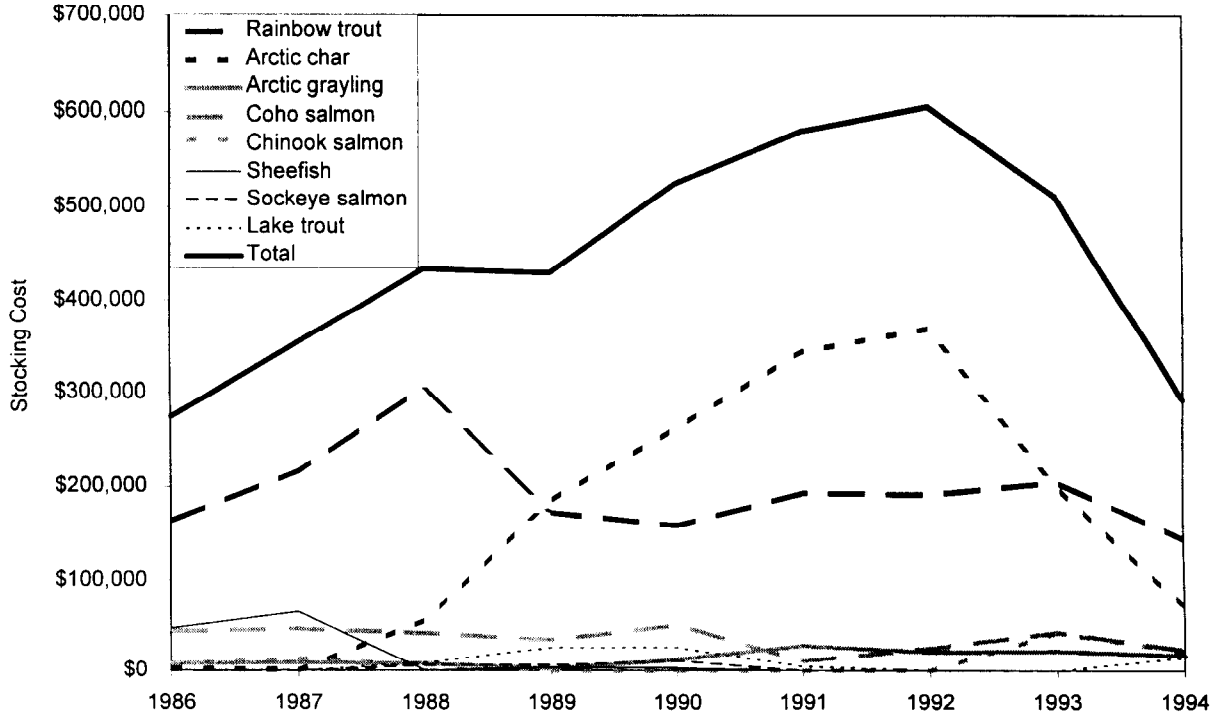

Figure 13.-Stocking costs, by species, in the Tanana Valley.

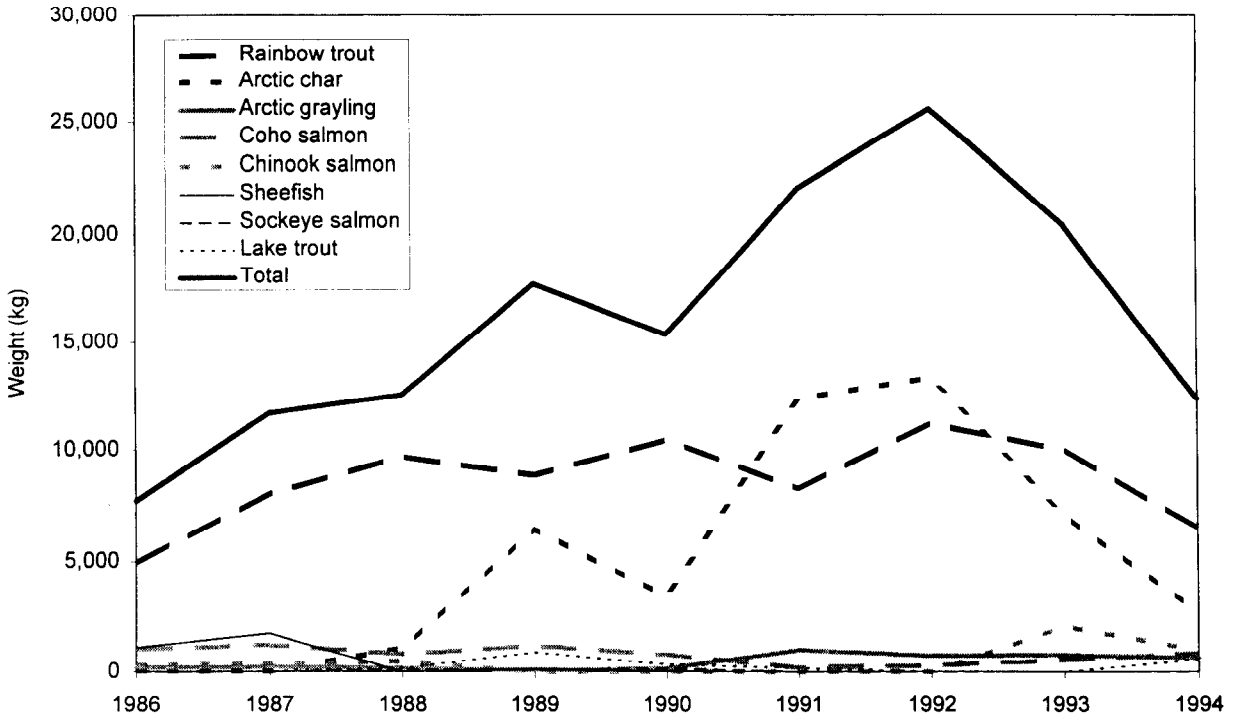

Figure 14.-Total weight of fish stocked, by species, in the Tanana Valley.

as lake trout, were stocked only in lakes where the species had proven to provide fisheries. Arctic grayling were not as widely stocked in the Tanana Valley as were rainbow trout (although Arctic grayling may have performed just as well as rainbow trout) because anglers were able to fish wild populations of Arctic grayling. Some species, such as sheefish and sockeye salmon are no longer stocked because fisheries did not develop.

Cost by Location

From 1987 through 1994, increases and decreases of the yearly cost for the overall stocking program generally were influenced most by the cost of stocking Harding Lake. Although several species were stocked in Harding Lake during this period, most of the annual costs were associated with the stocking of Arctic char and rainbow trout (Figure 13). The decrease in stocking costs for Harding Lake was the result of substantially reducing the stocking of Arctic char and ending the stocking of rainbow trout and the other species. Of all the species evaluated, Arctic char was the only species considered a success (Skaugstad 1994). The stocking of fish into Harding Lake was an experiment to increase the number and species of fish available to anglers and to evaluate alternative methods to rear fish.

In 1993, the stocking costs for the small lakes was higher than any other location. The high cost was probably the result of stocking larger and more expensive fish in urban ponds along the road system. This management strategy has resulted in the small lakes providing the most DF than any other fishery (wild or stocked) in the Tanana Valley. Although the stocking cost in 1993 was the highest of the stocked fisheries, the cost-per-day of fishing (CPDF) was less than those for Harding Lake and Piledriver Slough (Table 19).

Cost-per-Day of Fishing

The annual CPDF (all fisheries combined) was somewhat stable around $6 from 1986 through 1989 (Table 19; Figures 15 and 16). After 1989 the annual CPDF started to increase and reached its highest level (about $12) in 1992. In 1992 the total stocking cost reached its historic high (about $605,000) and effort was at its lowest level since 1986 (about 49,700 DF; Figures 3, 12, and 13). The combination of these two events resulted in a record high annual CPDF in 1992. In 1993 the annual CPDF dropped to about $7.50. This was the result of reducing total stocking costs and an increase in total effort for 1993.

From 1990 through 1992 increasing CPDF at most locations (Figures 15 and 16) was the result of declining effort and increasing stocking costs (Figures 4, 12, and 13). In 1993 effort increased but for most locations it was still less than the recent historic levels. The total cost of the stocking program, however, had declined since 1992. The two locations in 1993 where the CPDF significantly decreased (Harding Lake and small lakes) happened for different reasons. The decrease for Harding Lake was the result of greatly reduced stocking costs while effort had remained relatively constant since 1991. For the small lakes the reduction in CPDF was the result of increased effort even while stocking costs had increased each year since 1991. Birch Lake, where the CPDF significantly increased, was probably the result of a large increase in stocking costs and a small increase in effort. For Quartz Lake, Chena Lake, and Piledriver Slough there was little change in the CPDF. Any change in the number of days fished at these locations was probably offset by an increase in stocking cost which resulted in little or no change in the CPDF.

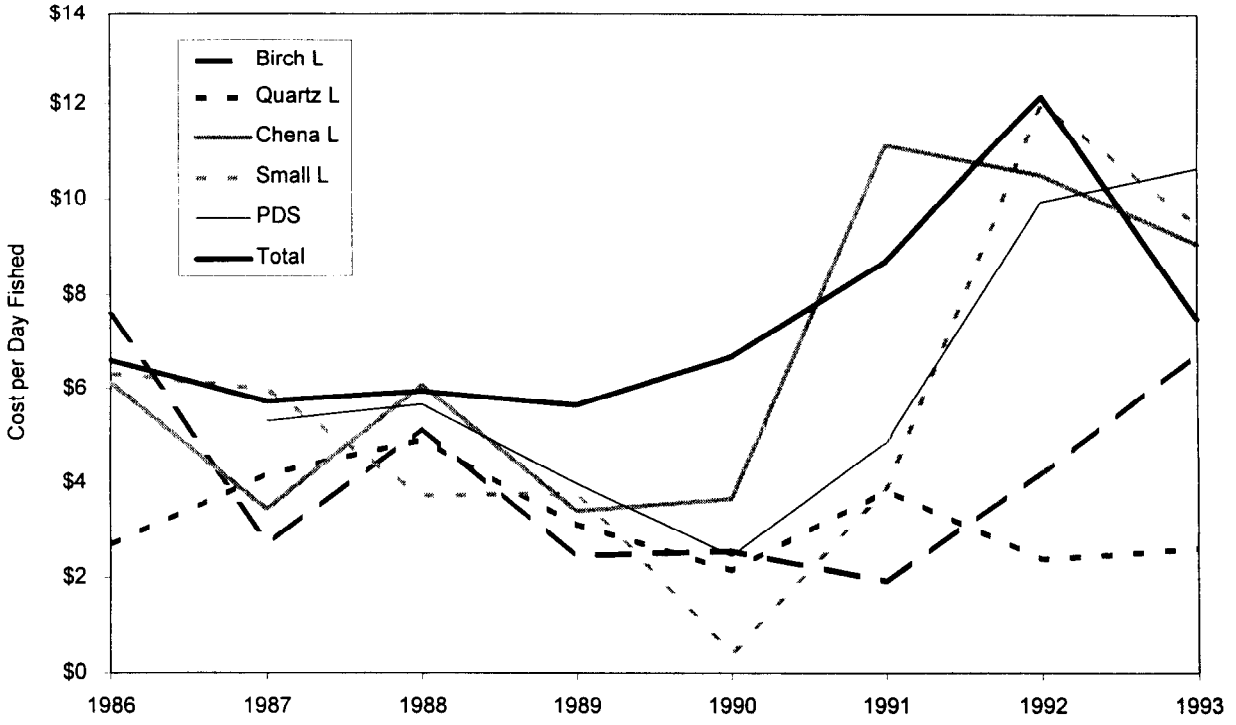

Figure 15.-Cost-per-day of fishing on populations of stocked game fish for the major locations in the Tanana Valley.

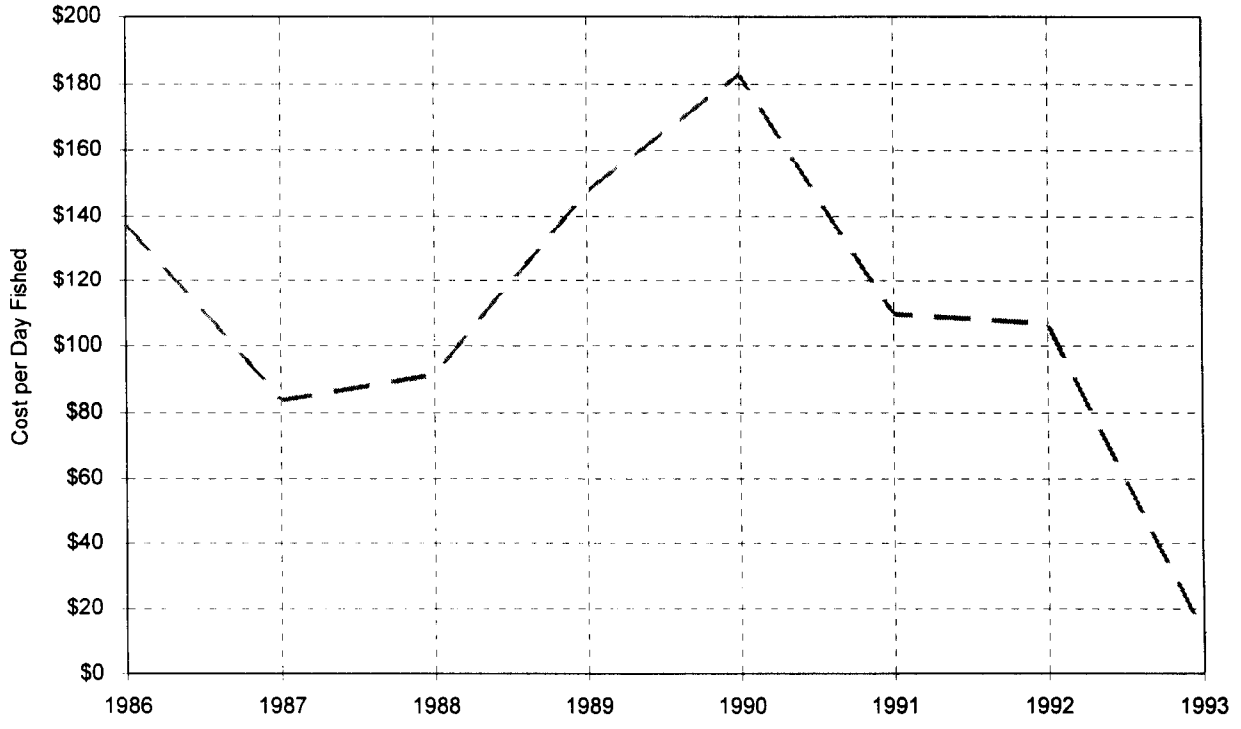

Figure 16.-Cost-per-day of fishing on populations of stocked game fish for Harding Lake.

Assessment of Management Objectives for 1992 and 1993

The management objectives from the FMPs are summarized in Table 21 along with the actual statistics for 1992 and 1993. The statistics that were reported by Skaugstad (1994) for 1992 were re-calculated using revised data. For 1993, the small lakes generated more effort than the objective (22,516 vs 20,000 DF) but at a higher CPDF than the objective ($9.47 vs $3.00 per DF). Quartz Lake nearly achieved the CPDF objective ($2.60 vs $2.50 per DF) but did not reach the effort objective (17,613 vs 20,000 DF). None of the other locations came close to achieving either their effort or CPDF objectives. The objectives for mean harvest rate were not achieved for any location. Birch, Quartz, Chena, and small lakes had a harvest rate of at least 1.0. Quartz Lake had the highest (1.57) while Harding Lake had the lowest (0.24).

Birch Lake

In 1993 there were 10,447 DF and 15,373 fish harvested (all species). The mean harvest rate was 1.47 fish per DF, the stocking cost was $70,368, and the CPDF was $6.73. The management objectives for Birch Lake are 15,000 DF, a mean harvest rate of two fish per DF, and a CPDF of no more than $2.00.

Quartz Lake

In 1993 there were 17,613 DF and 27,676 fish harvested (all species). The mean harvest rate was 1.57 fish per DF, the stocking cost was $45,706, and the CPDF was $2.60. The management objectives for Quartz Lake are 20,000 DF, a mean harvest rate of two fish per DF, and a CPDF of no more than $2.50.

Chena Lake

In 1993 there were 6,668 DF and 7,629 fish harvested (all species). The mean harvest rate was 1.14 fish per DF, the stocking cost was $60,480, and the CPDF was $9.07. The management objectives for Chena Lake are 10,000 DF, a mean harvest rate of two fish per DF, and a CPDF of no more than $2.00.

Piledriver Slough

In 1993 there were 8,627 DF on stocked fish and 6,007 stocked fish harvested. The number of DF on stocked fish was assumed to be one-half of the total number of DF for stocked and resident species. Rainbow trout was the only species stocked. The harvest does not include Arctic grayling, burbot, northern pike or other indigenous species. The mean harvest rate of stocked fish was 0.70 fish per DF, the stocking cost was $91,726 and the CPDF was $10.63. The management objectives for Piledriver Slough are 40,000 DF, a mean harvest rate of two fish per DF (including Arctic grayling), and a CPDF of no more than $2.00.

Small Lakes

In 1993 there were 22,516 DF and 22,557 fish harvested (all species) from the small lakes. The mean harvest rate was 1.00 fish per DF, the stocking cost was $213,291 and the CPDF was $9.47. The management objectives for the small lakes are 20,000 DF and a CPDF of no more than $3.00.

Harding Lake

In 1993 there were 2,443 DF on stocked fish and 586 stocked fish harvested. The number of DF on stocked fish was assumed to be one-half of the total number of DF for stocked and resident species. The harvest does not include resident lake trout, burbot, or northern pike. The mean harvest rate was 0.24 fish per DF, the stocking cost was $29,937 and the CPDF was $12.25. The

Table 21.-Summary of objectives from the Fishery Management Plans and statistics from the major fisheries in 1992 and 1993.

Management Plan	1992[a]	1993	Objective
Birch Lake:			
Days fished	10,072	10,447	15,000
Harvest	12,855	15,373	
Mean harvest rate	1.28	1.47	2
Stocking cost	$42,456	$70,368	
Cost-per-day of fishing	$4.22	$6.73	$2.00
Quartz Lake:			
Days fished	13,486	17,613	20,000
Harvest	20,597	27,676	
Mean harvest rate	1.53	1.57	2
Stocking cost	$32,025	$45,706	
Cost-per-day of fishing	$2.37	$2.60	$2.50
Chena Lake:			
Days fished	6,007	6,668	10,000
Harvest	5,829	7,629	
Mean harvest rate	0.97	1.14	2
Stocking cost	$63,045	$60,480	
Cost-per-day of fishing	$10.50	$9.07	$2.00
Piledriver Slough:			
Days fished[b]	6,804	8,627	20,000 [b]
Harvest[c]	5,454	6,007	
Mean harvest rate	0.80	0.70	2 [d]
Stocking cost	$67,634	$91,726	
Cost-per-day of fishing	$9.94	$10.63	$2.00

-continued-

Table 21.-Page 2 of 2.

Management Plan	1992[a]	1993	Objective
Small Lakes:			
Days fished[e]	10,794	22,516	20,000
Harvest[f]	6,579	22,557	
Mean harvest rate	0.61	1.00	
Stocking cost	$129,572	$213,291	
Cost-per-day of fishing	$12.00	$9.47	$3.00
Harding Lake:			
Days fished[g]	2,534	2,443	
Harvest[h]	2,085	586	
Mean harvest rate	0.82	0.24	
Stocking cost	$270,491	$29,937	
Cost-per-day of fishing	$106.74	$12.25	$3.00

[a] 1992 data were re-calculated using updated information.

[b] Only one-half of the estimated number of days fished from the SWHS were attributed to stocked rainbow trout.

[c] Piledriver Slough has wild Arctic grayling and stocked rainbow trout. The reported harvest numbers are for rainbow trout only.

[d] The mean harvest rate includes Arctic grayling.

[e] Some of these lakes have wild and stocked fish populations. The reported number of days fished were adjusted to account for stocked fish only (Table 18).

[f] The reported number of fish harvested are stocked fish only.

[g] Only one-half of the estimated number of days fished from the SWHS were attributed to fish that were stocked into Harding Lake.

[h] The reported number of fish harvested are for stocked fish only.

management objectives for Harding Lake are to maintain the current level of DF and mean harvest rate, and a CPDF of no more than $3.00.

DISCUSSION

Costs and the Number of Days Fished

The method used in this report to calculate CPDF oversimplified the relationship between stocking costs, cohort contribution, and the number of days fished. In this report stocking costs were attributed to the year that a cohort of fish was stocked but the fish usually do not significantly contribute to a fishery until at least one year after stocking. The time between stocking and when a cohort of fish make a significant contribution to a fishery depends on the size of the fish and when they were stocked. Fish stocked at a larger size contribute sooner than do fish that were stocked at a smaller size. The CPDF calculated for any year was based on the stocking cost and the number of days fished for that year. However, the fish that may have attracted anglers to a fishery and the fish that were harvested probably were from stockings that were made in prior years.

Another component to consider is that the total number of days fished at a location is not entirely dependent on stocking methods, stocking costs, or the quality of the fishery. Stocking methods were designed to maintain acceptable stocking costs while creating fisheries that were acceptable to anglers. Even for an acceptable fishery, weather and major events may affect anglers and their decision to participate in fisheries. Given this situation effort will most likely fluctuate with environmental and social conditions regardless of the quality of the fishery. The tenuous relationship between stocking costs and DF was very apparent in 1992 when stocking costs were at a historical high and effort was the lowest since 1986. This combination resulted in a record high CPDF. While we can account for the high stocking cost we have not been able to determine the cause for the large decrease in the total number of days fished in 1992. While we can manipulate stocking costs, our influence on anglers and their decision to participate in a fishery is usually indirect and limited to factors that we can control. Some of the factors that we can control include improving public access to fishing locations and managing fisheries to provide a desirable fishery.

Management Objectives

None of the management objectives were achieved for any of the fisheries in 1992 and only two were achieved in 1993. While we did not anticipate meeting these objectives in just one or two years it does not seem possible to meet all objectives for all locations unless effort increases beyond the historical high levels attained prior to 1991. Quartz Lake was the only location for which the fishery statistics for 1993 were close to all of its objectives. Although the small lakes exceeded the objective for effort, the CPDF was more than three times the objective. However, the changes that were made to the overall stocking program did result in lower total overall stocking costs in 1993 and 1994. The relatively low stocking costs in 1994 may result in more of the management objectives being met for other locations if effort continues to increase.

While the stocking program was modified to lower costs, it also was our intent to make the fisheries on stocked game fish more attractive to anglers. These changes should result in increased effort and harvest beginning in 1994. While stocking costs for 1994 are known, estimates of effort and harvest for 1994 will not be known until late in 1995.

Although it is difficult to establish a cause and effect relation between stocking methods and the number of days fished, we may reasonably expect effort to increase in the future and we should manage the stocking program to meet angler demand yet minimize stocking costs. Some examples of reducing stockings costs while maintaining or improving fisheries are: 1) stocking fingerling rainbow trout in Quartz Lake and subcatchable rainbow trout in Birch Lake; and, 2) multiple stockings of catchable rainbow trout in urban ponds. Although the cost per fish for stocking at Birch Lake was less for fingerlings, the cost-per-survivor to a catchable size was less for fish stocked as subcatchables. Apparently, in Birch Lake the higher rate of survival for subcatchables offset their higher stocking cost. Wiley et al. (1993) found similar results for the cost of stocked fish returned to the creel in Wyoming. The small urban ponds are close to Fairbanks and North Pole which makes them easily accessible for a large number of anglers. As a result we think these lakes receive a lot of fishing pressure for their size and they are probably quickly fished out. Havens et al. (1995) recommends similar stocking methods for lakes along the roadside in south-central Alaska. Stocking more fingerling-size fish is not a workable option because these ponds probably can not produce or sustain sufficient numbers of catchable rainbow trout to meet demand. Nehring (no date) reports that the production of quality size rainbow trout and brown trout in some Colorado streams is limited by environmental constraints. For these reasons, we plan to stock catchable size fish in these ponds two or more times during the summer in order to provide better fisheries close to town. Although the stocking cost for these ponds will increase, we expect the cost-to-the-creel and CPDF will decrease. Of course, to reduce stocking costs we can also drastically reduce the number and size of fish that are stocked. But we risk losing effort because anglers may no longer be drawn to fish populations that result from stockings designed primarily to reduce costs.

The stocking program is influenced by many factors such as production costs, number and size of fish when stocked, survival rates, and even angler desire. Changing one factor in the stocking program affects the other factors in ways that can be either positive or negative. A method to investigate the relation between these various factors is through system analysis. In system analysis, the various factors of stocking program and how the factors function individually and collectively are modeled. In the model, values and constraints are assigned to the factors and we can examine the effect of change to determine which factors have the most effect. Also, with non-linear programming we can determine the most parsimonious combination of values for the factors. A parsimonious solution will provide an acceptable level of benefits for an acceptable cost. This is a method of balancing costs and benefits when we want to keep stocking costs at a minimum but at the same time maintain a desirable fishery. Even though this method can provide a best solution for a given situation, it should only be used as a decision making tool and not as the justification for a decision. The fishery manager should use the solution as just one of many pieces of information that are used in the decision making process.

ACKNOWLEDGMENTS

Charmee Weker, Pat Houghton, Kelly Krueger, and Klaus Wuttig assisted with the field work. Marianne McNair and Irv Brock provided operational costs and fish production data for the hatcheries. The U.S. Fish and Wildlife Service provided partial funding for this study through the Federal Aid in Sport Fish Restoration Act (16 U.S.C. 777-777K) under Project F-10-10, Study E, Job No. 3-1.

LITERATURE CITED

ADF&G (Alaska Department of Fish and Game). 1993. Fishery Management Plans. Located at: Alaska Department of Fish and Game, Division of Sport Fish, 1300 College Rd., Fairbanks.

Baker, T. 1988. Creel censuses in interior Alaska in 1987. Alaska Department of Fish and Game, Fishery Data Series No. 64, Juneau.

Clark R. and W. Ridder. 1987. Tanana Drainage creel census and harvest surveys, 1986. Alaska Department of Fish and Game, Fishery Data Series No. 12, Juneau.

Doxey, M. R. 1980. Population studies of game fish and evaluation of managed lakes in the Salcha District with emphasis on Birch Lake. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1979-1980, Project F-9-12, 21(G-III-K):26-47.

Doxey, M. R. 1981. Population studies of game fish and evaluation of managed lakes in the Salcha District with emphasis on Birch Lake. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1980-1981, Project F-9-13, 22(G-III-K):38-59.

Doxey, M. R. 1982. Population studies of game fish and evaluation of managed lakes in the Salcha District with emphasis on Birch Lake. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1981-1982, Project F-9-14, 23(G-III-K):30-49.

Doxey, M. R. 1983. Population studies of game fish and evaluation of managed lakes in the Salcha District with emphasis on Birch Lake. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1982-1983, Project F-9-15, 24(G-III-K):39-66.

Doxey, M. R. 1984. Population studies of game fish and evaluation of managed lakes in the Salcha District with emphasis on Birch Lake. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1983-1984, Project F-9-16, 25(G-III-K):26-51.

Doxey, M. R. 1985. Population studies of game fish and evaluation of Alaska waters, Salcha District. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1984-1985, Project F-19-17, 26(G-III-K):67-96.

Doxey, M. R. 1986. Interior landlocked trout and salmon program. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1985-1986, Project F-10-1, 27(T-8-1):1-24.

Doxey, M. R. 1987. Tanana Drainage lake stocking evaluations, 1986. Alaska Department of Fish and Game, Fishery Data Series No. 31, Juneau.

Doxey, M. R. 1988. Evaluation of Stocked Waters in the Tanana Drainage, 1987. Alaska Department of Fish and Game, Fishery Data Series No. 73, Juneau.

Doxey, M. R. 1989. Evaluation of Stocked Waters in the Tanana Drainage, 1988. Alaska Department of Fish and Game, Fishery Data Series No. 106, Juneau.

Doxey, M. R. 1991. Evaluation of rainbow trout and coho salmon stocking programs in Birch, Chena, and Quartz Lakes, Alaska. Alaska Department of Fish and Game, Fishery Data Series No. 91-66, Anchorage.

Hallberg, J. E. 1984. Evaluation of interior Alaska waters and sport fish with emphasis on managed waters, Fairbanks District. Alaska Department of Fish and Game, Federal Aid in Fish Restoration, Annual Report of Progress, 1983-1984, Project F-9-16, 25(G-III): 50-84.

Hallberg, J. E. 1985. Evaluation of interior Alaska waters and sport fish with emphasis on managed waters, Fairbanks District. Alaska Department of Fish and Game, Federal Aid in Fish Restoration, Annual Report of Progress, 1984-1985, Project F-9-17, 26(G-III-H): 1-26.

Havens, A., T. Bradley, and C. Baer. 1995. Lake stocking manual for non-anadromous fisheries in southcentral Alaska. Alaska Department of Fish and Game, Special Publication No. 95-2, Anchorage.

LITERATURE CITED (Continued)

Kramer, M. J. 1977. Evaluation of Interior Alaska Waters and Sport Fish with Emphasis on Managed Lakes, Fairbanks District. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1976-1977, Project F-9-9, 18(G-III-H): 66-86.

Kramer, M. J. and J. Hallberg. 1982. Evaluation of Interior Alaska Waters and Sport Fish with Emphasis on Managed Waters, Fairbanks District. Alaska Department of Fish and Game, Division of Sport Fish. Federal Aid in Fish Restoration, Annual Report of Progress, 1981-1982, Project F-9-14, 23(G-III-H): 72-75.

Mills, M. J. 1980. Alaska statewide sport fish harvest studies. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1979-1980. Project F-9-12, 21 (SW-1): 65 pp.

Mills, M. J. 1981. Alaska statewide sport fish harvest studies. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1980-1981. Project F-9-13, 22 (SW-1): 78 pp.

Mills, M. J. 1982. Alaska statewide sport fish harvest studies. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1981-1982. Project F-9-13, 23 (SW-1): 115 pp.

Mills, M. J. 1983. Alaska statewide sport fish harvest studies. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1982-1983. Project F-9-14, 24 (SW-1): 118 pp.

Mills, M. J. 1984. Alaska statewide sport fish harvest studies. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1983-1984. Project F-9-16, 25 (SW-1): 122 pp.

Mills, M. J. 1985. Alaska statewide sport fish harvest studies. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1984-1985. Project F-9-17, 26 (SW-1): 88 pp.

Mills, M. J. 1986. Alaska statewide sport fish harvest studies. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1985-1986. Project F-9-18, 27 (SW-1): 137 pp.

Mills, M. J. 1987. Alaska statewide sport fish harvest studies. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1986-1987. Project F-9-19, 28 (SW-1): 91 pp.

Mills, M. J. 1988. Alaska statewide sport fisheries harvest report 1987. Alaska Department of Fish and Game, Fishery Data Series No. 52, Juneau.

Mills, M. J. 1989. Alaska statewide sport fish harvest studies. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Report of Progress, 1986-1987. Project F-9-19, 28 (SW-1): 91 pp.

Mills, M. J. 1990. Harvest, catch, and participation in Alaska sport fisheries during 1989. Alaska Department of Fish and Game, Fishery Data Series No. 90-44, Anchorage.

Mills, M. J. 1991. Harvest, catch, and participation in Alaska sport fisheries during 1990. Alaska Department of Fish and Game, Fishery Data Series No. 91-58, Anchorage.

Mills, M. J. 1992. Harvest, catch, and participation in Alaska sport fisheries during 1991. Alaska Department of Fish and Game, Fishery Data Series No. 92-40, Anchorage.

Mills, M. J. 1993. Harvest, catch, and participation in Alaska sport fisheries during 1992. Alaska Department of Fish and Game, Fishery Data Series No. 93-42, Anchorage.

Mills, M. J. 1994. Harvest, catch, and participation in Alaska sport fisheries during 1993. Alaska Department of Fish and Game, Fishery Data Series No. 94-28, Anchorage.

Nehring, R. B. Coldwater streams and special regulations: Management assessment report for the 1990s. State of Colorado, Department of Natural Resources, Division of Wildlife.

Ricker, W. E. 1975. Computation and interpretation of biological statistics of fish populations. Bulletin of the Fisheries Research Board of Canada 191: 382 pp.

Skaugstad, C. L., P. Hansen, and M. R. Doxey. 1994. Evaluation of stocked game fish in Birch, Quartz, Chena, and Harding lakes, 1993. Alaska Department of Fish and Game, Fishery Data Series No. 94-44, Anchorage.

LITERATURE CITED (Continued)

Skaugstad, C. L. and J. H. Clark. 1991. Evaluation of the stocking of mixed species of game fish in small lakes. Alaska Department of Fish and Game, Fishery Data Series No. 91-60, Anchorage.

Wiley, R. W., R. A. Whaley, J. B. Satake, and M. Fowden. 1993. Assessment of stocking hatchery trout: A Wyoming perspective. North American Journal of Fisheries Management 13:160-170.

APPENDIX A

Appendix A.-Stocking histories for Birch Lake, Quartz Lake, and Chena Lake.

Lake	Species	Date	Number Stocked	Average Weight(g)	Brood Source	Brood Year
Birch:	Rainbow trout	4-Oct-66	96,500	2.23	Winthrop NFH	66
	Rainbow trout	7-Oct-66	97,000	2.78	Winthrop NFH	66
	Rainbow trout	14-Jul-67	21,200	0.83	Winthrop NFH	67
	Rainbow trout	14-Jul-67	16,600	0.55	Winthrop NFH	67
	Rainbow trout	18-Jul-67	103,800	0.79	Winthrop NFH	67
	Rainbow trout	24-Jul-67	97,200	0.87	Winthrop NFH	67
	Rainbow trout	5-Sep-67	114,500	1.18	Winthrop NFH	67
	Rainbow trout	12-Aug-68	96,600	1.40	Winthrop NFH	68
	Rainbow trout	15-Aug-68	92,800	1.41	Winthrop NFH	68
	Rainbow trout	19-Aug-68	116,100	1.17	Winthrop NFH	68
	Rainbow trout	19-Sep-68	42,700	1.74	Winthrop NFH	68
	Rainbow trout	21-Jul-69	98,900	1.10	Winthrop NFH	69
	Rainbow trout	22-Jul-69	99,500	1.00	Winthrop NFH	69
	Rainbow trout	28-Jul-69	162,900	0.84	Winthrop NFH	69
	Rainbow trout	31-Jul-69	50,000	1.02	Winthrop NFH	69
	Rainbow trout	9-Sep-70	40,600	4.45	Winthrop NFH	70
	Rainbow trout	12-Sep-70	39,600	4.73	Winthrop NFH	70
	Rainbow trout	15-Sep-70	30,300	5.74	Winthrop NFH	70
	Rainbow trout	18-Sep-70	20,400	5.34	Winthrop NFH	70
	Rainbow trout	21-Sep-70	22,800	4.78	Winthrop NFH	70
	Rainbow trout	24-Sep-70	15,100	4.24	Winthrop NFH	70
	Rainbow trout	25-Sep-70	20,400	4.93	Winthrop NFH	70
	Rainbow trout	18-Aug-71	153,365	1.53	Roaring R H	71
	Rainbow trout	9-Sep-71	58,700	2.13	Roaring R H	71
	Rainbow trout	10-Sep-71	75,800	2.31	Roaring R H	71
	Rainbow trout	31-Aug-72	128,800	2.47	Winthrop NFH	72
	Rainbow trout	1-Sep-72	130,900	2.36	Winthrop NFH	72
	Rainbow trout	12-Sep-72	39,800	3.09	Winthrop NFH	72
	Coho salmon	1-Jun-74	18,567	9.20	Green River H	72
	Coho salmon	22-Aug-74	20,500	3.10	DCR	73
	Coho salmon	23-Aug-74	35,000	3.27	DCR	73
	Rainbow trout	8-Oct-74	9,800	4.42	Naknek R	74
	Coho salmon	2-Jun-75	5,907	17.00	Green River H	72
	Coho salmon	17-Jul-75	87,200	1.23	Bear L	74
	Coho salmon	14-Jun-76	54,900	2.04	Blind Slough	75

-continued-

Appendix A.-Page 2 of 9.

Lake	Species	Date	Number Stocked	Average Weight(g)	Brood Source	Brood Year
	Rainbow trout	15-Sep-76	292	80.29	Talarik Cr	75
	Rainbow trout	15-Sep-76	474	81.65	Swanson R	75
	Rainbow trout	26-May-77	24,600	3.78	Alaska-Ennis	77
	Rainbow trout	31-May-77	38,100	3.02	Alaska-Ennis	77
	Rainbow trout	31-May-77	5,850	3.60	Alaska-Ennis	77
	Rainbow trout	2-Jun-77	32,000	3.22	Alaska-Ennis	77
	Rainbow trout	22-Dec-77	129	8.56	Talarik Cr	77
	Rainbow trout	22-Dec-77	3,570	2.96	Naknek R	77
	Rainbow trout	6-Sep-78	5,920	2.83	Talarik Cr	78
	Rainbow trout	6-Sep-78	9,000	3.14	Alaska-Ennis	78
	Rainbow trout	21-May-79	29,016	25.34	Alaska-Ennis	78
	Rainbow trout	23-May-79	39,559	25.34	Alaska-Ennis	78
	Rainbow trout	24-May-79	25,010	25.34	Alaska-Ennis	78
	Rainbow trout	24-May-79	7,729	25.34	Alaska-Ennis	78
	Rainbow trout	22-May-80	50,000	25.12	Swanson R	79
	Coho salmon	27-May-80	4,787	2.83	Ship Cr	79
	Coho salmon	27-May-80	55,063	2.83	Seward Lagoon	79
	Rainbow trout	5-Jun-80	5,074	1.36	Swanson R	79
	Rainbow trout	19-May-81	50,654	22.68	Swanson R	80
	Coho salmon	19-May-81	29,810	1.50	Seward Lagoon	80
	Rainbow trout	8-Jun-82	97,261	7.69	Swanson R	81
	Rainbow trout	23-Aug-82	298,500	1.30	Swanson R	82
	Coho salmon	23-May-83	10,000	2.67	Clear Cr	82
	Rainbow trout	13-Jun-83	4,773	40.39	Swanson R	82
	Rainbow trout	15-Jun-83	5,276	42.21	Swanson R	82
	Rainbow trout	16-Jun-83	5,140	44.21	Swanson R	82
	Rainbow trout	17-Jun-83	1,504	44.21	Swanson R	82
	Rainbow trout	17-Jun-83	2,789	58.15	Big L (Big L)	82
	Rainbow trout	29-Aug-83	125,168	1.81	Swanson R	83
	Coho salmon	24-May-84	50,000	3.76	Wood Cr	83
	Rainbow trout	25-Jul-84	263,498	1.74	Swanson R	84
	Rainbow trout	27-Aug-84	6,465	2.78	Swanson R	84
	Coho salmon	31-May-85	55,539	3.66	Wood Cr	84
	Coho salmon	5-Jun-86	40,000	3.97	Wood Cr	85
	Rainbow trout	7-Jun-86	8,635	19.70	Swanson R	85

-continued-

Appendix A.-Page 3 of 9.

Lake	Species	Date	Number Stocked	Average Weight(g)	Brood Source	Brood Year
	Rainbow trout	7-Jun-86	8,070	19.67	Swanson R	85
	Rainbow trout	8-Jun-86	9,221	19.70	Swanson R	85
	Rainbow trout	8-Jun-86	9,210	19.70	Swanson R	85
	Rainbow trout	9-Jun-86	9,200	19.93	Swanson R	85
	Rainbow trout	9-Jun-86	9,104	19.93	Swanson R	85
	Rainbow trout	10-Jun-86	9,109	19.93	Swanson R	85
	Rainbow trout	10-Jun-86	9,104	19.93	Swanson R	85
	Rainbow trout	11-Jun-86	3,994	19.93	Swanson R	85
	Rainbow trout	11-Jun-86	7,721	19.93	Swanson R	85
	Rainbow trout	22-May-87	4,931	28.10	Swanson R	86
	Rainbow trout	26-May-87	9,041	29.92	Swanson R	86
	Rainbow trout	26-May-87	11,265	25.93	Swanson R	86
	Rainbow trout	27-May-87	936	28.10	Swanson R	86
	Rainbow trout	27-May-87	3,711	24.87	Swanson R	86
	Rainbow trout	29-May-87	4,155	22.92	Swanson R	86
	Coho salmon	3-Jun-87	40,000	4.85	Wood Cr	86
	Rainbow trout	15-Mar-88	5,000	32.75	Swanson R	87
	Rainbow trout	16-Mar-88	5,000	32.75	Swanson R	87
	Rainbow trout	23-May-88	10,363	26.30	Swanson R	87
	Rainbow trout	24-May-88	11,626	24.05	Swanson R	87
	Rainbow trout	24-May-88	11,883	24.10	Swanson R	87
	Rainbow trout	25-May-88	10,851	25.20	Swanson R	87
	Coho salmon	3-Jun-88	40,000	3.33	Wood Cr	87
	Rainbow trout	22-Mar-89	16,657	16.42	Swanson R	88
	Rainbow trout	30-Mar-89	17,379	15.66	Swanson R	88
	Rainbow trout	3-Apr-89	15,964	16.57	Swanson R	88
	Coho salmon	6-Jun-89	40,000	4.24	Wood Cr	88
	Rainbow trout	2-Aug-89	4,045	111.90	Swanson R	88
	Rainbow trout	7-Jun-90	48,345	22.90	Swanson R	89
	Coho salmon	16-Jul-90	26,000	2.70	Big L (Big L)	89
	Coho salmon	19-Jul-90	105,000	2.70	Big L (Big L)	89
	Rainbow trout	4-Jun-91	25,153	22.90	Swanson R	90
	Coho salmon	11-Jul-91	40,303	0.99	Big L (Big L)	90
	Arctic char	19-Jul-91	13,365	11.03	Clear (Alek)	90
	Arctic char	23-Jul-91	5,235	11.06	Clear (Alek)	90

-continued-

Appendix A.-Page 4 of 9.

Lake	Species	Date	Number Stocked	Average Weight(g)	Brood Source	Brood Year
	Arctic grayling	16-Sep-91	40,000	4.93	Moose L	91
	Rainbow trout	10-Jun-92	24,494	30.00	Swanson R	91
	Arctic grayling	17-Jun-92	318,000	0.02	Moose L	92
	Arctic char	1-Sep-92	15,327	58.00	Domestic	91
	Arctic grayling	18-Sep-92	20,000	4.00	Moose L	92
	Arctic grayling	22-Sep-92	23,936	3.90	Moose L	92
	Arctic grayling	25-Sep-92	3,525	3.90	Moose L	92
	Rainbow trout	17-May-93	12,256	72.40	Swanson R/N3	92
	Rainbow trout	20-May-93	15,956	59.00	Swanson R/N3	92
	Coho salmon	14-Jun-93	8,830	11.00	Big Lake	91
	Coho salmon	24-Jun-93	79,800	0.82	Little Su	92
	Arctic grayling	16-Sep-93	20,000	4.15	Moose L	93
	Chinook salmon	7-Oct-93	12,861	67.60	Willow Cr	92
	Coho salmon	24-Apr-94	40,000	4.24	Wood Creek	93
	Rainbow trout	18-Jun-94	24,726	42.00	Swanson	93
	Coho salmon	13-Jul-94	4,900	5.49	Wood Creek	93
	Arctic char	11-Aug-94	4,557	29.86	Domestic	93
	Arctic char	12-Aug-94	3,851	30.00	Domestic	93
	Arctic char	25-Aug-94	3,436	39.60	Domestic	93
	Arctic grayling	30-Aug-94	20,000	3.48	Moose L	94
	Arctic char	7-Sep-94	12,184	39.40	Domestic	93
Quartz:	Rainbow trout	18-Jun-71	810,000	0.20	Winthrop NFH	71
	Rainbow trout	23-Jun-72	59,900	3.06	Ennis NFH	72
	Rainbow trout	26-Jun-72	30,800	2.78	Ennis NFH	72
	Rainbow trout	14-Jul-72	62,000	2.93	Ennis NFH	72
	Rainbow trout	20-Jul-72	57,200	3.57	Ennis NFH	72
	Rainbow trout	24-Jul-72	47,700	4.28	Ennis NFH	72
	Rainbow trout	26-Jul-72	49,200	4.16	Ennis NFH	72
	Rainbow trout	1-Aug-73	64,300	4.24	Winthrop NFH	73
	Rainbow trout	6-Aug-73	72,500	4.63	Winthrop NFH	73
	Rainbow trout	13-Aug-73	69,300	4.32	Winthrop NFH	73
	Rainbow trout	15-Aug-73	79,000	4.49	Winthrop NFH	73
	Rainbow trout	10-Jul-74	39,700	0.77	Winthrop NFH	74
	Rainbow trout	16-Aug-74	41,700	3.05	Winthrop NFH	74

-continued-

Appendix A.-Page 5 of 9.

Lake	Species	Date	Number Stocked	Average Weight(g)	Brood Source	Brood Year
	Rainbow trout	20-Aug-74	41,200	3.05	Winthrop NFH	74
	Rainbow trout	21-Aug-74	37,200	3.41	Winthrop NFH	74
	Rainbow trout	22-Aug-74	16,800	3.29	Winthrop NFH	74
	Rainbow trout	28-Aug-74	7,700	3.83	Winthrop NFH	74
	Rainbow trout	24-Jul-75	68,000	2.65	Ennis NFH	75
	Rainbow trout	28-Jul-75	93,000	2.44	Ennis NFH	75
	Rainbow trout	29-Jul-75	48,900	2.56	Ennis NFH	75
	Rainbow trout	2-Aug-76	100,000	0.68	Williamette H	76
	Rainbow trout	24-Aug-76	7,900	4.51	Crooked Cr	76
	Rainbow trout	24-Aug-76	47,400	1.74	Williamette H	76
	Coho salmon	23-Jun-77	143,000	1.15	Seward Lagoon	76
	Rainbow trout	26-Jul-77	110,500	1.49	Alaska-Ennis	77
	Rainbow trout	11-Aug-77	3,301	39.44	Alaska-Ennis	77
	Coho salmon	15-Aug-77	54,400	2.67	Seward Lagoon	76
	Coho salmon	15-Aug-78	4,600	3.13	Seward Lagoon	77
	Coho salmon	17-Aug-78	50,606	3.52	Seward Lagoon	77
	Rainbow trout	13-Sep-79	32,858	1.60	Swanson R	79
	Coho salmon	21-Sep-79	150,095	8.02	Seward Lagoon	78
	Rainbow trout	28-Aug-80	87,559	1.22	Swanson R	80
	Coho salmon	14-May-81	109,914	1.21	Seward Lagoon	80
	Coho salmon	19-May-81	39,400	1.50	Seward Lagoon	80
	Rainbow trout	15-Sep-82	226,600	1.26	Swanson R	82
	Coho salmon	23-May-83	46,543	2.67	Clear Cr	82
	Rainbow trout	29-Aug-83	233,172	1.36	Swanson R	83
	Coho salmon	24-May-84	6,000	3.76	Wood Cr	83
	Coho salmon	29-May-84	45,200	4.34	Wood Cr	83
	Coho salmon	30-May-84	15,150	4.34	Wood Cr	83
	Coho salmon	31-May-84	62,568	1.83	Seward Lagoon	83
	Coho salmon	12-Jun-84	26,800	1.90	Seward Lagoon	83
	Rainbow trout	15-Aug-84	252,000	2.05	Swanson R	84
	Rainbow trout	21-Aug-84	21,567	2.24	Swanson R	84
	Coho salmon	28-May-85	64,970	3.50	Wood Cr	84
	Coho salmon	29-May-85	65,706	3.50	Wood Cr	84
	Coho salmon	30-May-85	19,300	3.66	Wood Cr	84
	Rainbow trout	15-Jul-85	100,000	0.93	Swanson R	85

-continued-

Appendix A.-Page 6 of 9.

Lake	Species	Date	Number Stocked	Average Weight(g)	Brood Source	Brood Year
	Rainbow trout	21-Aug-85	72,148	2.18	Swanson R	85
	Rainbow trout	23-Aug-85	74,361	1.65	Swanson R	85
	Rainbow trout	26-Aug-85	51,500	1.60	Swanson R	85
	Rainbow trout	27-Aug-85	21,720	1.77	Swanson R	85
	Rainbow trout	30-Aug-85	67,647	1.74	Swanson R	85
	Coho salmon	31-May-86	57,557	4.18	Wood Cr	85
	Coho salmon	4-Jun-86	40,365	3.82	Wood Cr	85
	Coho salmon	4-Jun-86	40,365	3.82	Wood Cr	85
	Coho salmon	6-Jun-86	30,213	3.97	Wood Cr	85
	Rainbow trout	15-Aug-86	107,198	1.44	Swanson R	86
	Rainbow trout	15-Aug-86	48,587	1.44	Swanson R	86
	Rainbow trout	18-Aug-86	84,546	1.78	Swanson R	86
	Rainbow trout	20-Aug-86	56,546	1.62	Swanson R	86
	Rainbow trout	22-Aug-86	27,988	1.62	Swanson R	86
	Rainbow trout	8-Oct-86	5,000	1.62	Swanson R	86
	Coho salmon	29-Apr-87	38,342	2.33	Wood Cr	86
	Coho salmon	1-May-87	46,747	1.95	Wood Cr	86
	Rainbow trout	27-May-87	10,000	28.11	Swanson R	86
	Coho salmon	3-Jun-87	35,556	5.09	Wood Cr	86
	Coho salmon	4-Jun-87	47,844	4.75	Wood Cr	86
	Rainbow trout	11-Aug-87	227,917	2.40	Swanson R	87
	Rainbow trout	26-Aug-87	101,795	2.23	Swanson R	87
	Coho salmon	25-May-88	65,597	3.39	Wood Cr	87
	Coho salmon	26-May-88	61,148	3.39	Wood Cr	87
	Coho salmon	26-May-88	23,255	3.39	Wood Cr	87
	Rainbow trout	27-May-88	9,663	25.83	Swanson R	87
	Rainbow trout	27-May-88	11,328	22.50	Swanson R	87
	Rainbow trout	1-Jun-88	10,738	26.45	Swanson R	87
	Rainbow trout	2-Jun-88	9,898	26.45	Swanson R	87
	Rainbow trout	12-Aug-88	150,000	0.98	Swanson R	88
	Rainbow trout	24-Apr-89	8,306	35.70	Swanson R	88
	Rainbow trout	25-Apr-89	1,344	35.70	Swanson R	88
	Rainbow trout	30-May-89	9,705	25.80	Swanson R	88
	Rainbow trout	31-May-89	4,028	25.00	Swanson R	88
	Coho salmon	31-May-89	58,659	4.00	Wood Cr	88

-continued-

Appendix A.-Page 7 of 9.

Lake	Species	Date	Number Stocked	Average Weight(g)	Brood Source	Brood Year
	Coho salmon	2-Jun-89	38,175	4.04	Wood Cr	88
	Rainbow trout	7-Aug-89	150,000	1.20	Swanson R	89
	Rainbow trout	7-Jun-90	33,843	22.90	Swanson R	89
	Coho salmon	16-Jul-90	52,000	2.70	Big L (Big L)	89
	Coho salmon	17-Jul-90	98,000	2.70	Big L (Big L)	89
	Rainbow trout	19-Jul-90	150,632	1.20	Swanson R	90
	Rainbow trout	12-Sep-90	52,914	2.40	Swanson R	90
	Rainbow trout	17-May-91	25,005	20.30	Swanson R	90
	Rainbow trout	17-Jun-91	17,711	24.90	Swanson R	90
	Coho salmon	8-Jul-91	105,825	1.03	Big L (Big L)	90
	Coho salmon	11-Jul-91	45,960	0.99	Big L (Big L)	90
	Arctic char	16-Jul-91	75,000	10.55	Clear (Alek)	90
	Rainbow trout	31-Jul-91	152,000	2.00	Swanson R	91
	Rainbow trout	10-Jun-92	25,967	30.00	Swanson R	91
	Arctic char	19-Jun-92	30,000	10.00	Domestic	91
	Rainbow trout	16-Jul-92	325,563	1.60	Swanson R	92
	Rainbow trout	22-Jul-92	75,046	1.20	Swanson R	92
	Coho salmon	14-Jun-93	7,655	11.00	Big Lake	91
	Coho salmon	24-Jun-93	160,600	0.80	Little Su	92
	Rainbow trout	22-Jul-93	203,858	1.37	Swanson R	93
	Rainbow trout	27-Jul-93	217,043	1.30	Swanson R	93
	Chinook salmon	6-Oct-93	12,568	67.60	Willow Cr	92
	Coho salmon	23-May-94	81,304	4.24	Wood Creek	93
	Arctic char	21-Jun-94	20,000	10.70	Domestic	93
	Arctic char	28-Jun-94	10,000	8.66	Domestic	93
	Rainbow trout	11-Jul-94	179,406	1.33	Swanson R	94
	Rainbow trout	13-Jul-94	201,000	1.20	Swanson R	94
	Coho salmon	13-Jul-94	9,800	5.49	Wood Creek	93
Chena:	Rainbow trout	8-Jun-82	7,134	56.70	Swanson R	81
	Rainbow trout	8-Jun-82	20,417	7.69	Swanson R	81
	Coho salmon	8-Jun-82	21,233	1.50	Bear Cr (Sew)	81
	Coho salmon	17-Jun-82	6,374	2.03	Bear Cr (Sew)	81
	Rainbow trout	14-Sep-83	30,592	1.67	Swanson R	83
	Rainbow trout	22-May-84	9,425	25.00	Big L (Big L)	83

-continued-

Appendix A.-Page 8 of 9.

Lake	Species	Date	Number Stocked	Average Weight(g)	Brood Source	Brood Year
	Rainbow trout	23-May-84	9,154	25.00	Big L (Big L)	83
	Coho salmon	25-May-84	30,000	3.76	Wood Cr	83
	Rainbow trout	25-Jul-84	47,529	1.74	Swanson R	84
	Arctic grayling	29-Aug-84	36,813	1.38	Moose L	84
	Coho salmon	30-May-85	30,000	3.66	Wood Cr	84
	Steelhead trout	7-Jun-85	7,700	56.70	Anchor R	84
	Steelhead trout	7-Jun-85	7,500	56.70	Anchor R	84
	Coho salmon	3-Jun-86	30,000	3.82	Wood Cr	85
	Rainbow trout	17-Jun-86	14,702	56.35	Big L (Big L)	85
	Rainbow trout	15-Jul-86	14,400	79.40	Big L (Big L)	85
	Arctic grayling	1-Oct-86	400	8.06	Moose Cr	86
	Rainbow trout	21-May-87	12,212	114.10	Swanson R	86
	Rainbow trout	21-May-87	4,214	114.00	Swanson R	86
	Coho salmon	1-Jun-87	30,000	5.21	Wood Cr	86
	Rainbow trout	16-Jun-87	2,890	154.40	Swanson R	86
	Chinook salmon	19-May-88	32,885	8.61	Crooked Cr	87
	Rainbow trout	19-May-88	11,792	95.40	Big L (Big L)	87
	Coho salmon	26-May-88	15,000	3.39	Wood Cr	87
	Rainbow trout	10-Jun-88	4,216	89.70	Big L (Big L)	87
	Rainbow trout	21-Jul-88	6,012	100.00	Big L (Big L)	87
	Rainbow trout	8-Aug-88	3,642	90.00	Swanson R	87
	Rainbow trout	8-Aug-88	4,429	63.00	Swanson R	87
	Arctic char	17-Jan-89	1,596	144.40	Aleknagik L	87
	Arctic char	3-Feb-89	902	142.80	Aleknagik L	87
	Coho salmon	2-Jun-89	15,000	4.04	Wood Cr	88
	Rainbow trout	9-Jun-89	7,935	78.50	Swanson R	88
	Rainbow trout	19-Jun-89	12,238	96.00	Swanson R	88
	Rainbow trout	21-Jul-89	10,308	103.00	Swanson R	88
	Rainbow trout	4-Jun-90	23,092	97.10	Swanson R	89
	Rainbow trout	12-Jul-90	8,159	107.00	Swanson R	89
	Arctic char	30-May-91	250	761.00	Aleknagik L	89
	Arctic char	30-May-91	330	738.00	Aleknagik L	89
	Arctic char	3-Jun-91	36	2,134.00	Aleknagik L	86
	Arctic char	3-Jun-91	364	761.00	Aleknagik L	89
	Rainbow trout	17-Jun-91	16,010	96.80	Swanson R	90

-continued-

Appendix A.-Page 9 of 9.

Lake	Species	Date	Number Stocked	Average Weight(g)	Brood Source	Brood Year
	Coho salmon	11-Jul-91	16,364	0.99	Big L (Big L)	90
	Rainbow trout	15-Jul-91	10,966	109.00	Swanson R	90
	Arctic char	10-Sep-91	16,900	35.60	Clear (Alek)	90
	Arctic grayling	16-Sep-91	13,000	4.93	Moose L	91
	Rainbow trout	10-Jun-92	10,367	30.00	Swanson R	91
	Rainbow trout	17-Jun-92	9,424	123.00	Swanson R	91
	Rainbow trout	25-Jun-92	600	91.00	Swanson R	91
	Arctic char	2-Sep-92	10,000	62.00	Domestic	91
	Coho salmon	18-Sep-92	10,428	18.00	Big Lake	91
	Arctic grayling	20-Sep-92	15,000	3.60	Moose L	92
	Rainbow trout	20-May-93	14,639	79.20	Swanson R/AF	92
	Coho salmon	14-Jun-93	3,160	11.00	Big Lake	91
	Coho salmon	21-Jun-93	30,000	0.73	Big Lake	92
	Coho salmon	24-Jun-93	30,000	0.89	Little Su	92
	Rainbow trout	2-Sep-93	1,500	107.00	Swanson R/N3	92
	Arctic grayling	15-Sep-93	15,000	4.15	Moose L	93
	Arctic char	16-Sep-93	6,000	106.00	Domestic	92
	Chinook salmon	6-Oct-93	2,584	67.60	Willow Cr	92
	Chinook salmon	7-Oct-93	2,625	67.60	Willow Cr	92
	Coho salmon	20-May-94	15,000	4.32	Wood Creek	93
	Rainbow trout	18-Jun-94	16,628	42.00	Swanson R	93
	Arctic char	11-Aug-94	10,000	29.86	Domestic	93
	Arctic grayling	1-Sep-94	20,000	4.00	Moose L	94
	Arctic grayling	21-Sep-94	3,835	4.14	Moose L	94
	Chinook salmon	6-Oct-94	6,589	71.30	Willow Ck	93

APPENDIX B

Appendix B1.-Estimated abundance and percent survival to age 1 for rainbow trout in Birch Lake, 1979 - 1990.

Stocking Date	Abundance Estimate	SE	Percent Survival	SE	Stocking Size Cohort	Size at Stocking (g)
5/24/79	22,533	2,815	22.2	3.0	Subcatchable	25
5/22/80	31,259	1,927	56.9	1.0	Subcatchable	25
5/19/81	22,560	3,636	54.7	7.0	Subcatchable	23
6/08/82	28,191	983	27.0	1.0	Small Subcatchable	8
8/23/82	3,565	291	1.2	0.1	1982 Fingerling	1.3
6/17/83	15,585	80	----		Subcatchable	45
8/29/83	2,727	122	2.2	0.1	1983 Fingerling	1.9
7/25/84	3,971	248	1.4	0.1	1984 Fingerling	1.7
6/11/86	56,191	2,372	67.4	3.0	Subcatchable	21
5/29/87	18,589	786	54.6	2.0	Subcatchable	25
3/17/88	4,068	947	40.6	9.0	Subcatchable	32
5/25/88	25,766	2,200	57.6	5.0	Subcatchable	25
4/03/89	14,159	2,075	28.3	4.0	Subcatchable	16
8/02/89	4,045	-----	100.0	---	Catchable	112
6/7/90	25,129	3,631	52.0	0.6	Subcatchable	23

Appendix B2.-Estimated abundance and percent survival to age 1 for rainbow trout in Quartz Lake 1987-1990.

Stocking	Abundance		Percent Survival		Stocking	
Date	$\hat{N}$	SE	$\hat{S}$	SE	Size Cohort	Size (g)
27 May 1987	1,419	91	14.2	1.0	Subcatchable	28
26 Aug 1987	28,718	3,596	7.0	2.0	Fingerling	2.3
2 Jun 1988	13,871	1,915	28.0	4.0	Subcatchable	25
12 Aug 1988	Combined				Fingerling	1
31 May 1989	15,935	3,358			Subcatchable	26
24 Apr 1989	2,116	754	9.2	2.0	Subcatchable	17-36
7 Aug 1989	Combined				Fingerling	1.2
7 Jun 1990	23,425	3,886			Subcatchable	23

[a] Standard error (SE) of the abundance estimate from the mark-recapture (M-R) experiments.

APPENDIX C

Appendix C.-Comparison of differences between estimates of harvest from creel surveys and the brood tables for rainbow trout at Birch Lake.

Age Cohort	1980	1981	1982	1983	Average
Age 1					
Creel Survey	1,697	4,811	0	1,478	
Brood Tables	3,661	894	0	4,144	
Difference	-1,964	3,917	0	-2,666	178
Age 2					
Creel Survey	16,263	13,081	15,645	8,752	
Brood Tables	13,122	15,950	16,461	8,433	
Difference	3,141	-2,869	-816	319	56
Age 3					
Creel Survey	0	2,923	2,640	4,711	
Brood Tables	1,944	4,777	1,924	1,451	
Difference	-1,944	-1,854	716	3,260	44

APPENDIX D

Appendix D.-Average cost per fish that survived to a catchable size (180 mm) for rainbow trout stocked at various sizes in Birch, Quartz, and Chena lakes, 1974-1989.

Stocking Year	Cohort Size	Number Stocked	Average Weight(g)	Stocking Cost	Cost per Fish	Survival Rate	Number of Survivors	Cost per Survivor	Average Cost per Survivor
Birch Lake									
1974	F	9,800	4.4	$776	$0.08	0.11	1,088	$0.71	
1977	F	104,249	3.5	$6,568	$0.06	0.1	10,425	$0.63	
1978	F	95,079	3	$5,134	$0.05	0.1	9,508	$0.54	
1982	F	298,500	1.3	$6,985	$0.02	0.012	3,582	$1.95	
1983	F	125,218	1.8	$4,057	$0.03	0.022	2,755	$1.47	
1984	F	269,963	1.8	$8,747	$0.03	0.014	3,779	$2.31	$1.04
1979	S	101,314	25.3	$46,211	$0.46	0.22	22,492	$2.05	
1980	S	55,074	25.1	$24,882	$0.45	0.57	31,337	$0.79	
1981	S	50,654	22.7	$20,679	$0.41	0.55	27,708	$0.75	
1982	S	97,261	7.7	$13,459	$0.14	0.27	26,260	$0.51	
1983	S	19,482	44	$15,430	$0.79	0.8	15,586	$0.99	
1986	S	83,368	19.8	$29,712	$0.36	0.674	56,190	$0.53	
1987	S	34,039	27	$16,543	$0.49	0.55	18,585	$0.89	
1988	S	54,723	28	$27,580	$0.50	0.49	26,869	$1.03	
1989	S	50,000	16	$14,400	$0.29	0.28	14,150	$1.02	$0.87
1976	C	766	81.2	$1,120	$1.46	1	766	$1.46	
1989	C	4,045	111.9	$8,147	$2.01	1	4,045	$2.01	$1.93
Quartz Lake									
1974	F	185,100	3	$9,995	$0.05	0.07	12,957	$0.77	
1975	F	209,900	2.5	$9,521	$0.05	0.07	14,693	$0.65	
1976	F	155,300	2.1	$5,959	$0.04	0.07	10,871	$0.55	
1977	F	110,500	1.8	$3,580	$0.03	0.07	7,735	$0.46	
1979	F	32,858	1.6	$946	$0.03	0.07	2,300	$0.41	
1980	F	87,559	1.2	$1,921	$0.02	0.07	6,129	$0.31	
1982	F	226,600	1.3	$5,139	$0.02	0.07	15,862	$0.32	
1983	F	233,272	1.4	$5,715	$0.02	0.07	16,329	$0.35	
1984	F	273,567	2.1	$10,341	$0.04	0.07	19,150	$0.54	
1985	F	287,376	1.4	$7,242	$0.03	0.07	20,116	$0.36	
1986	F	301,877	1.5	$8,151	$0.03	0.07	21,131	$0.39	
1987	F	407,917	2.3	$16,888	$0.04	0.07	28,554	$0.59	
1988	F	150,000	0.98	$2,646	$0.02	0.07	10,500	$0.25	$0.47
1977	S	3,301	39.4	$2,344	$0.71	0.17	564	$4.15	
1987	S	10,000	28.1	$5,060	$0.51	0.14	1,420	$3.56	
1988	S	48,094	24.5	$21,209	$0.44	0.28	13,466	$1.58	
1989	S	47,323	25.2	$21,454	$0.45	0.092	4,354	$4.93	$2.53

-continued-

Appendix D.-Page 2 of 2.

Stocking Year	Cohort Size	Number Stocked	Average Weight(g)	Stocking Cost	Cost per Fish	Survival Rate	Number of Survivors	Cost per Survivor	Average Cost per Survivor
Chena Lake									
1982	F	20,417	7.7	$2,830	$0.14	0.02	408	$6.93	
1983	F	30,691	1.7	$923	$0.03	0.02	614	$1.50	
1984	F	47,529	1.7	$1,489	$0.03	0.02	951	$1.57	$2.66
1982	S	7,134	57	$7,319	$1.03	0.9	6,421	$1.14	
1984	S	18,579	25	$8,361	$0.45	0.5	9,290	$0.90	
1985	S	15,800	56.7	$16,125	$1.02	0.8	12,640	$1.28	
1986	S	29,102	68	$35,621	$1.22	0.9	26,192	$1.36	$1.24
1987	C	25,406	114	$52,133	$2.05	1	25,406	$2.05	
1988	C	30,091	92	$49,831	$1.66	1	30,091	$1.66	
1989	C	30,481	96	$52,671	$1.73	1	30,481	$1.73	$1.80

Survival rates to a catchable size were from Doxey (1991). The stocking cost was based on $18 per kilogram which was a reasonable estimate of the average hatchery cost of producing and stocking a kilogram of fish (Table 20).

APPENDIX E

Appendix E.-The number of days fished (DF) by location, total harvest and stocking costs for waters stocked with game fish in the Tanana Valley.

	Number of Days Fished (DF)						Total		
Year	Birch Lake	Quartz Lake	Chena Lake	Harding Lake[a]	PDS[a,b]	Small Lakes[a]	Days Fished	Harvest	Stocking Costs
1977	8,118	6,317				6,442	20,877	13,143	
1978	8,982	6,845				6,204	22,031	28,818	
1979	7,804	10,150				5,227	23,181	41,259	
1980	17,036	13,994				9,796	40,826	45,317	
1981	14,233	19,599				6,348	40,180	81,865	
1982	16,677	18,254				7,583	42,514	69,560	
1983	15,882	14,162				7,048	37,092	54,919	
1984	13,170	15,922	11,044	427		9,247	49,810	63,267	
1985	14,444	16,456	11,288			4,955	47,143	74,474	
1986	9,969	18,486	8,853	516		3,612	41,436	55,331	$274,155
1987	15,375	20,410	9,472	1,281	6,629	8,466	61,633	58,390	$353,060
1988	15,607	19,391	9,404	814	12,188	15,662	73,065	110,687	$434,169
1989	14,284	18,299	16,180	1,234	11,373	14,854	76,224	93,289	$429,868
1990	15,541	19,746	12,875	1,948	13,853	14,686	78,648	78,086	$525,129
1991	13,893	15,478	9,444	2,578	8,852	16,449	66,693	100,783	$579,953
1992	10,072	13,486	6,007	2,534	6,804	10,794	49,697	54,307	$605,222
1993	10,447	17,613	6,668	2,443	8,627	22,516	68,313	72,453	$511,508

[a] These locations include stocked and wild game fish. The number of days fished for these locations were adjusted to reflect the number of days attributed to stocked game fish only.

[b] PDS = Piledriver Slough.

APPENDIX F

Appendix F.-Data files for information collected from fish populations in Birch Lake, Quartz Lake, Chena Lake, and Harding Lake, 1994.

File Name	Description
U0090LA4.DTA[a]	Data file of catches by species, location, depth, gear type, an biological information for fish captured in Birch Lake, 1994.
U0100LA4.DTA[a]	Data file of catches by species, location, depth, gear type, an biological information for fish captured in Quartz Lake, 1994.
U0180LA4.DTA[a]	Data file of catches by species, location, depth, gear type, an biological information for fish captured in Chena Lake, 1994.

[a] Data files have been archived at and are available from the Alaska Department of Fish and Game, Sport Fish Division, Research and Technical Services, 333 Raspberry Road, Anchorage, Alaska, 99518-1599.